BOTANICAL GAZETTE

NOVEMBER, 1894.

Popular American plant-names. III.

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IN this paper the writer has, for convenience, discarded the systematic arrangement of names of genera, under families, and adopted the alphabetical arrangement. It has also seemed best, in view of the threatened revolution in nomenclature, to give the authorities for the scientific names used, as far as these could be conveniently ascertained. In a few instances the Spanish names of species (mainly of the Pacific coast region) have been given, but it has been the writer's intention to insert these only when they are commonly current among English-speaking people as well as among the Mexicans.

UMBELLIFERÆ.

Angelica, sp., Aunt Jerichos, N. E.

Daucus Carota, L., Queen Anne's lace, somewhat general.
bird's nest, N. J.
lace-flower,[1] Philadelphia, Pa.
Devil's plague,[1] West Va.

Erigenia bulbosa, Nutt., turkey-pea,[2] near Cincinnati, O., fifty years ago.

Pastinaca sativa, L., queen-weed, West Va.

ARALIACEÆ.

Aralia hispida, Vent., pigeon-berry, Buckfield, Me.

Aralia nudicaulis, L., sassafariller, Banner Elk, N. C.

Aralia quinquefolia, Decaisne & Planch., sang,[3] West Va.
ginshang, Vt.

Aralia racemosa, L., spice-bush, Hartford, Conn.

[1] The former evidently a city-born name, the latter from the point of view of the farmer, who finds the species a pestilent weed.

[2] Name given in a former list, but without locality.

[3] Evidently an abbreviation for ginseng.

Aralia racemosa, L., life-o'-man, Fryeburg, Me.
old man's root, Buckfield, Me.
spignet, Banner Elk, N. C.

CORNACEÆ.

Cornus florida, L., nature's mistake, Abington, Mass., about fifty years ago.
Cornus stolonifera, Michx., squaw-bush,[1] Penobscot Co., Me.
Nyssa sylvatica, Marsh., horn-bine, horn-pine, Southern States.
old man's beard, Lincolnton, N. C.
Linnæa borealis, L., deer-vine, Me.
Lonicera Tatarica, L., "twin sisters," La Crosse, Wis.
Symphoricarpus occidentalis, Hook., wolf-berry, buck-brush, W. Neb.
Symphoricarpus racemosus, Michx., waxberry, N. Y.
Viburnum lantanoides, Michx., moose-berry, triptoe,[2] hobble-bush,[2] Franconia, N. H.
tangle-foot,[2] N. H.
moose-bush, Buckfield, Me.
Viburnum nudum, L., nanny-berry, West Va., Livingston Co., N. Y., Ferrisburgh, Vt.
possum-berry, Ocean Springs, Miss.
Viburnum lentago, L., wild raisin, Penobscot Co., Me.

RUBIACEÆ.

Cephalanthus occidentalis, L., pond buttonwood, crouper-bush. Ferrisburgh, Vt.
Galium Mollugo, L. (and other sp.), mist, babies' breath, E. Mass.
Houstonia cærulea, L., eye-bright, W. Maine, Cambridge, Mass.
starlights, Cambridge.
Venus's pride, Stonington, Conn.

DIPSACEÆ.

Dipsacus sylvestris, Mill., Indian thistle, Huttonweed,[3] English thistle, water-thistle,[4] West Va.

COMPOSITÆ.

Actinomeris squarrosa, Nutt., wing-stem, stickweed, West Va.
Ambrosia Artemisiæfolia, L., bitterweed, N. Y., Neb.
Anaphalis margaritacea, Benth. & Hook., poverty-weed, Penobscot Co., Me.

[1] The bark is said to have been smoked by the Indians for tobacco.
[2] From the fact that the branches often take root at the ends.
[3] Because found on the farm of a man named Hutton.
[4] From the amount of water often found in the concavity of the leaves next the stem.

Antennaria plantaginifolia, Hook., pincushions, Hingham, Mass.
dog-toes, Concord, Mass.
splinter-weed,[1] Peoria, Ill.

Anthemis Cotula, D. C., stinking chamomile, N. Y.

Artemisia Absinthium, L., boys' love,[2] Wellfleet, Mass.

Artemisia Abrotanum, L., sweet Benjamin, Concord, Mass.

Artemisia Ludoviciana, Nutt., sage, Minn.

Artemisia tridentata, Nutt., sage-brush, Neb., Rocky Mountain region.

Aster cordifolius, L., var. *lævigatus*, Blue Devil, stick-weed, bee-weed, Fall Aster, West Va.

Aster diffusus, Ait., var. *hirsuticaulis*, Gray, white devil, wire-weed, devil-weed, Old Virginia stick-weed, old-field-sweet, farewell-summer, nail-rod, West Va.

Asters of any kind, Michaelmas daisies, N. Y.

Asters of any species, it-brings-the-frost, Onondaga Indians, N. Y.

Aster (a purple species), Good-by Summer, Lincolnton, N. C.

Baccharis halimifolia, L., ploughman's spikenard, N. Y.

Baccharis viminea, D. C., black willow, Santa Barbara Co., Cal.

Bidens frondosa, L., cuckles,[3] Concord, Mass.
Devil's pitchfork, Ferrisburgh, Vt., Concord, Mass.

Bidens, sp., stick-tights, N. Y.

Cacalia, sp., Indian plantain, West Va.

Centaurea benedicta, L., sweet sultan, Mattapoisett, Mass.

Centaurea, sp., dusty miller, Boston Florists' catalogue.

Chondrilla juncea, L., skeleton weed, naked weed, hog bite, Devil's grass, West Va.

Chrysanthemum leucanthemum, L., Kellup weed, Rhode Island clover, Montpelier, Vt.
bullseye, Me., Andover, N. B., West Va.
bullseye daisy, Andover, N. B.
sheriff pink, West Va.

Chrysanthemum parthenioides, hort., double feverfew, double feather-few, camphor geranium, bridal roses, West. Mass.

Cichorium Intybus, L., bachelor's button, Mass., So. Cal.

[1] Name used by a few children, from the appearance of the heads.

[2] Has this name been given because the plant was confounded with *Artemisia Abrotanum?*

[3] A corruption of cockles. This may be "the *Cuckold*, a troublesome weed in plough-lands, whose seeds have horns" mentioned in Williamson's *History of Maine*, 1832.

Cnicus arvensis, Hoffm., Canada thistle, E. Neb.
Cnicus lanceolatus, Hoffm., boar thistle, West Va.
Coreopsis, sp., old maid's breastpin, Plymouth, O.
dye-flowers, Banner Elk, N. C.
Elephantus tomentosus, L., tobacco weed, Devil's grandmother, W. Va.
Eupatorium ageratoides, L., richweed, Banner Elk, N. C.
Eupatorium cœlestinum, L., mist-flower, blue boneset, West Va.
Eupatorium purpureum, L., quill-wort, Indian gravel root,[1] West Va.
nigger-weed, queen-of-the-meadow, Ind.
marsh milk-weed, Mass.
Fransenia Hookeriana, Nutt., sand-bur, Cal.
Gnaphalium polycephalum, Michx., Indian posy, Stonington, Ct.
moonshine, Dorset, Vt.
balsam, N. Y.
rabbit-tobacco, N. C.
Grindelia robusta, Nutt., gum-plant, Cal.
Hemizonia pungens, T. & G., tar-weed, Cal.
Hieracium aurantiacum, L., Flora's paint brush, Oxford Co. and Penobscot Co., Me.
Iva frutescens, L., Jesuit's bark, N. Y.
Krigia amplexicaulis, Nutt., False dandelion, W. Va.
Lactuca Canadensis, L., Horse-weed, Devil's iron-weed, Devil's weed, West Va.
Lactuca integrifolia, Bigel., Devil's iron weed, W. Va.
Leontodon autumnalis, L., arnica bud, dog dandelion, Allston, Mass.
Liatris scariosa, Willd., Devil's bite,[2] Concord, Mass.
Madia sativa, Molina, tar-weed, Berkeley, Cal.
Matricaria discoidea, D. C., wild marigold, Col. Springs, Cal.
Porophyllum gracile, Benth., poison flower, Colorado River.
Prenanthes altissima, L., bird-bell, N. Y.
Parthenium integrifolium, L., wild quinine, W. Ind.
Rudbeckia hirta, L., brown daisy, Concord, Mass.
ox-eye daisy, somewhat general in Mass.
Brown Betty, Passaic, N. J.
Rudbeckia triloba, L., nigger-heads, Anderson, Ind.
Senecio aureus, L., snake-root,[3] Concord, Mass.
Solidago, sp., yellow-weed, Vt.
Solidago bicolor, L., silver-weed, N. Y.
Solidago, sp., pyramid golden-rod, N. Y.
Tragopogon porrifolius, L., nap-at-noon, Hennepin, Ill.
Tussilago Farfara, L., ginger-root, Minn.

[1] Apparently thought to be a remedy for calculi.
[2] Because the corm or tuber is thought to look as if bitten off.
[3] From the aromatic and bitterish flavor of the roots, like that of *Polygala Senega*.

LOBELIACEÆ.

Lobelia cardinalis, L., hog physic, Plymouth Co., Mass.
red Betty, Ferrisburgh, Vt.
Lobelia Dortmanna, L., water gladiole, N. Y.
Lobelia inflata, L., low belia.[1]
Lobelia syphilitica, L., high belia.[1]

ERICACEÆ.

Andromeda ligustrina, Muhl., seedy buckberry, West Va.
Arbutus Menziesii, Pursh, madroño, Cal.
Arctostaphylos glauca, Lindl., manzanita, Cal.
Arctostaphylos Uva-ursi, Spreng., hog-cranberry, Provincetown, Mass.
mountain cranberry, Southern Me.
Chimaphila umbellata, Nutt., wintergreen, Buckfield, Me., Penobscot Co., Me.
Chiogenes serpyllifolia, Salisb., running birch, Vt.
moxie berry, Penobscot Co., Me.
Gaultheria procumbens, L., partridge-berry, N. H.
partridge-plant, N. Y.
chickaberry, Stonington, Ct.
(young leaves) { young come-ups, Ferrisburgh, Vt.
little Johnnies, Calais, Me.
Gaultheria Shallon, Pursh, salad, Cal.
Gaylusaccia resinosa, Torr. & Gr., black snaps, Wells, Me.
Kalmia angustifolia, L., ivy, Va.
Kalmia latifolia, L., ivy, N. C.
Ledum latifolium, Ait., Labrador, Buckfield, Me.
Leucothoe, sp., hemlock, N. C.
Monotropa uniflora, L., Dutchman's pipe, N. J.
fairy smoke, Deering, Me.
Pyrola elliptica, Nutt., wild lily-of-the-valley, Concord, Mass.
Rhododendron maximum, L., cow-plant, Montpelier, Vt.
horse-laurel, White Haven, Pa.
Rhododendron, all species, laurel, N. C.
Rhododendron nudiflorum, Torr., wild honeysuckle, Georgia, W Va.
Mayflower, N. J.
Rhododendron viscosum, Torr., swamp honeysuckle, Concord, Mass., Boxford, Mass.
white honeysuckle, Ala.
Rhododendron viscosum, Torr., var. *glaucum*, Gray, cinnamon honeysuckle, West Va.
Sarcodes sanguinea, Torr., snow-plant, Cal.

[1] Somewhat general among herb-collectors.

Vaccinium hirsutum, Buckley, bear-huckleberry, N. C.
Vaccinium Pennsylvanicum, Lam., strawberry-huckleberries, Weymouth, Mass.

DIAPENSIACEÆ.

Galax aphylla, L., coltsfoot, Banner Elk, N. C.

PRIMULACEÆ.

Dodecatheon Meadia, L., Indian chief, Rockford, Ill.
Johnny jump, So. Cal.
Dodecatheon Meadia, var. shooting stars, roosters' heads, Santa Barbara Co., Cal.
Lysimachia nummularia, L., down-hill-of-life, Lincolnton, N. C.
Lysimachia stricta (?) Ait., swamp candles, N. E.
Trientalis Americana, Pursh, star-anemone, Concord, Mass.
May-star, N. Y.
Star-of-Bethlehem, E. Mass.

STYRACACEÆ.

Halesia tetraptera, L., shittimwood, West Va.
Symplocos tinctoria, L'Her., dye-leaves, Banner Elk, N. C.

OLEACEÆ.

Osmanthus Americana, Benth. & Hook., devil-wood, Ala.

APOCYNACEÆ.

Apocynum androsæmifolium, L., rheumatism-weed, West Va.
Macrosiphonia brachysiphon, Gray, jessamine, Arizona.

ASCLEPIADACEÆ.

Asclepias cornuti, Decaisne, wild cotton, West Va.
Asclepias tuberosa, L., white root, Mass.
Archangel, (near) Providence, R. I.

GENTIANACEÆ.

Erythræa Muhlenbergii, Griseb., conchalagua, Cal.
Eustoma Russelianum, Griseb., Canada pest, Deer Lodge, Mont.
Gentiana Andrewsii, Griseb., bottle-gentian, barrel-gentian, Concord, Mass.
blind-gentian, N. E.
Sabbatia angularis, Pursh, pink bloom, West Va.

HYDROPHYLLACEÆ.

Eriodictyon glutinosum, Benth., palo santo, yerba santa, Cal.
Nemophila insignis, Dougl., baby-blue-eyes, blue-bells, Santa Barbara Co., Cal.

BORRAGINACEÆ.

Cynoglossum, sp., stick-seed, dog-bur, wool-mat, West Va.
Cyonglossum officinale, L., dog-bur, West Va.
stick-tights, Anderson, Ind.
tory-bur,[1] N. Y.
Echinospermum Lappula, Lehm.,
E. Redkowskii, Lehm., var. *occidentale*, Watson,
E. Virginicum, Lehm., } stick-tight, Minn.
Echinospermum Virginicum, stick-tights, Anderson, Ind.
Echium vulgare, L., blue thistle, blue weed, blue stem, West Va.
blue thistle, Va., N. Y.
blue devils, blue weed, Iowa.
Krynitzkia, sp., Fischer & Meyer, white forget-me-nots, Santa Barbara Co., Cal.
Lithospermum canescens, Lehm., Indian paint, Minn.

CONVOLVULACEÆ.

Convolvulus sepium, L., woodbine, N. Y.
Cuscuta compacta, Juss., love-vine,[2] Banner Elk, N. C.
Cuscuta racemosa, Mart., alfalfa dodder, Cal.
Ipomæa pandurata, Meyer, wild sweet potato, West Va.
mechoacanna, N. Y.

SOLANACEÆ.

Datura Stramonium, L., stinkweed, West Va. ; Jamestown lily, Lincolnton, N. C.
Datura Tatula, L., Jamestown lily, Lincolnton, N. C.
Lycium vulgare, Dunal., box-thorn, bastard jasmine, Iowa.
Nicotiana Bigelovii, Watson, wild tobacco, Santa Barbara Co., Cal.
Nicotiana glauca, Graham, tree tobacco, Santa Barbara Co., Cal.
Nicotiana rustica, L., Indian tobacco, real tobacco, N. Y.
Physalis, sp., wild cherry, N. J.
Physalis grandiflora, Hook., wild tomato, No. Minn.
Physalis Virginiana, Mill., wild cherry, No. Minn.
Solanum Carolinense, L., sand-brier, radical, West Va.
bull-nettle, Perrysville, Ind.
Solanum rostratum, Dunal., buffalo-bur, So. Neb.

SCROPHULARIACEÆ.

Calceolaria corymbosa, Ruiz. & Par., lady's slipper, Hopkinton, Iowa.
Castillea coccinea, Spreng., bloody warrior, Minn.
nosebleed, Conn.

[1] Name perhaps now obsolete.
[2] Probably because used in love-divinations.

Castillea coccinea, Spreng., Indian pink, Peoria, Ill.
Chelone, sp., snake-mouths, Banner Elk, N. C.
Collinsia verna, Nutt., blue-eyed Marys, Anderson, Ind.
Linaria vulgaris, Mill., wild flax, devil's flax, wild tobacco, Indian hemp, impudent lawyer, West Va.
snap-dragon, Cambridge, Mass.
Veronica Americana, Schweinitz, blue-bells,[1] Fort Fairfield, Me.
wallink, West Va.
Veronica officinalis, L., gypsy-weed, West Va.

BIGNONIACEÆ.

Catalpa Bignonioides, Walt., catawba, West Va.

PEDALIACEÆ.

Martynia proboscidea, Glox., pickled rats,[2] N. Y.

VERBENACEÆ.

Lantana, sp., tea-plant, Louisiana.
Verbena hastata, L., iron-weed, Jones Co., Iowa.

LABIATÆ.

Audibertia polystachya, Benth., grease-wood,[3] So. Cal.
Brunella vulgaris, L., blue curls, somewhat general.
dragon-head, Deer Lodge, Mont.
Coleus Blumei, Benth., Joseph's coat, general.
Conradina canescens, Gray, wild rosemary, Fla.
Isanthus cæruleus, Michx., flux-weed, New Albany, Ind.
Lamium amplexicaule, L., hen-bit, Iowa.
Melissa officinalis, L., lemon-balm, common balm, sweet Mary, lemon-lobelia (pronounced lobely), N. E.
goose-tongue, Concord, Mass.
Monarda, sp., sweet Mary, N. H.
Nepeta Glechoma, Benth., Gill-run-over-the-ground, Conn.
Pycnanthemum lanceolatum, Pursh, pennyroyal, Minn.
Salvia Ballotæflora, Benth., majorano, Texas and adjacent Mexico.
Scutellaria lateriflora, L., mad-dog-skull-cap, West Va.

PLANTAGINACEÆ.

Plantago lanceolata, L., buck-plantain, buck-horn plantain, ripple, ribwort, English plantain, West Va.
Plantago Rugelii, Decaisne, silk-plant, Fla.

[1] The stigma is said to form the clapper.
[2] Name apparently transferred from the fruit, as seen pickled, to the entire plant.
[3] One of the shrubs so called.

AMARANTACEÆ.

Amarantus salicifolius, hort., fountain-plant,[1] Boston florists' catalogue.

CHENOPODIACEÆ.

Chenopodium Botrys, L., ambrosia, Concord, Mass.
Chenopodium Capitatum, Watson, Indian paint,[2] Colorado, Tobique River, New Brunswick.
Salsola Kali, L., Russian thistle, No. Neb.
Salsola Kali, var. *Tragus*, Moguin, Russian thistle, Russian cactus, Dak.
Sarcobatus vermiculatus, Torr., greasewood, Neb.

POLYGONACEÆ.

Polygonella articulata, Meisn., sand-grass, Wellfleet, Mass.
Polygonum orientale, L., gentleman's cane,[3] Mansfield, O.
Polygonum Persicaria, L., heartsease,[4] Eastport, Me., Mansfield, O.
heart-weed,[4] Penobscot Co., Me.
black heart,[4] So. Vt.
Polygonum amphibinum, L., var. *terrestre*, Leers., heartsease,[5] Neb.
Rumex acetosella, L., horse-sorrel, Minn.
red sorrel, red weed, West Va.
sour grass, Hartford, Conn.

ARISTOLOCHIACEÆ.

Asarum arifolium, Michx., heart-leaves, Ga.
Asarum Virginicum, L., heart-leaves, Banner Elk, N. C.
Asarum Canadense, L., coltsfoot, N. Y.
colic-root, West Va.

LAURACEÆ.

Persea Carolinensis, Nees., red bay, Ala., N. C.
white bay, N. C.
Umbellularia Californica, Nutt., California olive, California laurel, cajeput, Cal.

THYMELEACEÆ.

Dirca palustris, L., wicopy,[6] Penobscot Co., Me.

[1] From drooping habit of foliage.
[2] Because of the bright color of the fruit.
[3] The stems cut by children into canes.
[4] From the shape of the dark spots on the leaves.
[5] A name also applied in the same localities to *P. Pennsylvanica* and *P. Persicaria*, — used very generally by bee-keepers.
[6] An Indian name.

ELEAGNACEÆ.

Shepherdia argentea, Nutt., buffalo-berry, Upper Missouri.

EUPHORBIACEÆ.

Croton monanthogynus, L. (?), prairie tea,[1] common from the Gila to the Rio Grande.

Eremocarpus setigerus, Benth., turkey mullein, Santa Barbara Co., Cal.

Euphorbia Cyparissias, L., balsam, Mooers, N. Y.
graveyard-weed, West Va.

Euphorbia Lathyris, L., mole-weed, West Va.

Simmondsia, sp., "supposed to be the quinine plant," So. Arizona.

Stillingia Sylvatica, L., queen's delight (corrupted into "queen of the lights"), Ga.

URTICACEÆ.

Broussonetia papyrifera, Vent., cut paper, West Va.

Celtis occidentalis, L., hoop-ash, beaver-wood, N. Y.

Maclura aurantiaca, Nutt., wild orange, N. J.

PLATANACEÆ.

Platanus occidentalis, L., button-ball, N. J.

JUGLANDACEÆ.

Carya alba, Nutt., kiskytom, Otsego Co., N. Y.
king-nut, West Va.
walnut, N. E., Minn.

MYRICACEÆ.

Myrica Gale, L., meadow-fern, Dover, Me.

CUPULIFERÆ.

Betula glandulosa, Michx., scrub birch, Mich.

Betula lenta, L., cherry birch, Canada.

Betula papyrifera, Marshall, spool-wood, N. H.

Betula populifolia, Ait., pin-birch,[2] Penobscot Co., Me.

Betula pumila, L., tag alder, Minn.

Carpinus Caroliniana, Walter, iron-wood,[3] Ky.

[1] Used as tea.

[2] A name given especially to the young trees, an inch or more in diameter, which are cut into hoop-poles, etc.

[3] *Ostrya Virginica*, which in Gray's *Manual* is also called iron-wood, is in Kentucky known only as hop-hornbeam or lever-wood. This nomenclature is also that of Wood's *Botany*, and, I fancy, may be the usual one.

Fagus sylvatica, L., white beech, red beech, N. Y.
Ostrya Virginica, Willd., hardhack, Franconia, N. H.
Quercus agrifolia, Nee., scrub oak, evergreen oak, Cal.
encino (Mexicans), Cal.
Quercus Catesbæi, Michx., forked-leaved black jack, S. C.
Quercus chrysolepis, Liebm., Californian live oak, Cal.
Quercus cinerea, Michx., blue jack, S. C.
Quercus lobata, Nee., Roble (Mexicans), Cal.
Quercus oblongifolia, Torr., evergreen white oak, live oak, Cal.
Quercus stellata, Wang., iron oak, West Va.
Quercus Wislizeni, A. De C., var. *frutescens*, Engelm., desert oak, S. E. Cal.

SALICACEÆ.

Populus tremuloides, Michx., quaking asp, Mansfield, O., N. E., Iowa.
Salix, sp. (any of those with large catkins, when buds are opening),
pussy-willows, U. S.
goslings, Franklin Centre, P. Q.

EMPETRACEÆ.

Corema Conradii, Torr., poverty-grass, Provincetown, Mass.
Empetrum nigrum, L., hog cranberry, Islands of Penobscot Bay, Me.

CONIFERÆ.[1]

Abies balsamea, Miller, blister pine, balm of Gilead fir, West Va.
Abies Douglasii, Oregon pine,[2] San Francisco, Cal.
Chamæcyparis Lawsoniana, Parlat., Oregon cedar, white cedar, ginger-pine, Oregon and No. Cal.
Chamæcyparis Nutkaensis, Spach, Alaska cedar, Washington.
yellow cedar, Alaska.
Cupressus Guadalupensis, Watson, blue cypress, Cal.
Cupressus macrocarpa, Hartw., Monterey cypress, So. Cal.
Juniperus tetragona, Schlecht., sweet-berried cedar, New Mex.
Larix Americana, Michx., cypress, Buckfield, Me.
juniper,[3] Penobscot Co., Me., Grand Lake region of Penobscot River, Me.
Libocedrus decurrens, Torr., white cedar, Cal.
Picea alba, Link, cat-pine, Buckfield, Me.
skunk-spruce,[4] Mt. Desert, Me., Washington Co., Me., Islands of Penobscot Bay, Me.

[1] Most of the names of Rocky Mountain and Pacific Coast *Coniferæ* in the present paper were contributed by Mr. J. A. Allen, of the Gray Herbarium.
[2] Called spruce in some regions, hemlock in others.
[3] Hardly ever called by any other name.
[4] From supposed unpleasant smell of foliage.

Picea nigra, Link, cat-spruce, Penobscot Co., Me.
yew-pine, spruce-pine, West Va.
Pinus Banksiana, Lambert, jack-pine, Mich. and Minn.
shore-pine, rock-pine, Grand Lake section of Penobscot River.
the unlucky tree,[1] Adirondacks.
Pinus brachyptera, Engelm., yellow pine,[2] Cal. and New Mex.
Pinus edulis, Engelm., piñon (Mexicans), nut-pine of New Mex., or simply nut-pine (Americans), Tex. to Cal.
Pinus Lambertiana, Dougl., sugar-pine, Cal.
Pinus ponderosa, Dougl., yellow pine, Cal.
Pinus ponderosa, var. *scopulorum*, Engelm., bull-pine, Black Hills.
Pinus resinosa, Ait., Norway pine, Washington Co., Me., Minn.
Pseudotsuga Douglasii, Carr., Oregon pine, San Francisco, Cal.
Taxus Canadensis, Willd., creeping hemlock, West Va.
Thuya occidentalis, L., white cedar, Minn.
cedar,[3] Penobscot Co., Me.
Torreya Californica, Torr., nutmeg-tree, Cal.

ORCHIDACEÆ.

Arethusa bulbosa, L., wild pink, Atlantic City, N. J.
laughing jackass (locality ?).
Calopogon, sp., grass pink, Fla.
Corallorhiza, sp., crawley, N. C.
Corallorhiza multiflora, Nutt., dragons' claws, N. Y.
Cypripedium, any sp., ducks,[4] Wyoming Valley, Pa.
Cypripedium, sp., whip-poor-will shoe (Indians), N. Y.
Cypripedium acaule, Ait., valerian,[5] Franconia, N. H.
whip-poor-will's shoes, squirrels' shoes, Conn.
Goodyera pubescens, R. Br., ratsbane, Banner Elk, N. C.
Habenaria orbiculata, Torrey, Solomon's seal, Vt.
Habenaria psycodes, Gray, soldier's plume, N. Y.
Orchis spectabilis, L., purple orchis, N. Y.
Spiranthes, sp., ladies' tresses, ladies' dresses, ladies' traces (the latter two corruptions) (locality ?).
Spiranthes, sp., spiral orchid, N. H.

[1] It is believed that some calamity will befall whoever stands under this pine, and that it is especially unlucky for women to do so.

[2] Called pitch-pine in some regions.

[3] Never called by any other name.

[4] When the flower is partly filled with sand and set afloat on water, it looks like a duck.

[5] Probably on account of its supposed efficacy as a cure for nervous disorders. The plant has a wide reputation as a remedy in such cases.

Spiranthes cernua (?), Richard., screw-auger, Nova Scotia.
Spiranthes gracilis, Bigelow, twisted stalk, West Va.

IRIDACEÆ.

Gladiolus, sp., sword lily, N. Y.
Jacob's ladder, Lincolnton, N. C.
Iris prismatica, Pursh, *Iris versicolor*, L., } poison flag-root, Concord, Mass.
Sisyrinchium angustifolium, Mill., blue-grass, grass-flower, star-eyed grass, Concord, Mass. (children).

AMARYLLIDACEÆ.

Agave, sp., Indian maguey, New Mex.
Agave Virginica, L., rattlesnake's master, S. C.
Narcissus Poeticus, L., *Narcissus Pseudo-narcissus*, L., } Easter flowers,[1] Lincolnton, N. C.
Narcissus Pseudo-narcissus, L., butter and eggs, Martha's Vineyard, Mass.
Zephyranthes Atamasco, Herb., Easter lily, Macon, Ga.

DIOSCOREACEÆ.

Dioscorea villosa, L., colic-root, West Va.

LILIACEÆ.

Allium, sp., ramps, Banner Elk, N. C.
Allium Schœnoprasum, L., shore onion, Andover, N. B.
Allium tricoccum, Ait., ramps, West Va.
Amianthium muscætoxicum, Gray, crow-poison, Banner Elk, N. C.
Brodiæa capitata, Benth., hog onion,[2] Spanish lily, Santa Barbara Co., Cal.
Calochortus (several species), Mariposa lilies, Santa Barbara Co., Cal.
Calochortus Nuttallii, T. & G., Mariposa lily, Deer Lodge, Mont.
Clintonia borealis, Raf., dogberry, Bath, Me.
bear-plum, Franconia, N. H.
Northern lily, Penobscot Co., Me.
wild corn, Oxford Co., Me.
wild lily-of-the-valley, Concord, Mass.
Erythronium albidum, Nutt., *Erythronium Americanum*, Ker., } Deer's tongue, Anderson, Ind.
Erythronium albidum, lily, Peoria, Ill.
Erythronium Americanum, trout-flower (local), N. Y.

[1] Name also applied to Ranunculus and many early species of Lilium.
[2] The corm tastes like elm-bark, and is eaten by children.

Erythronium Americanum, lambs' tongues, Banner Elk, N. C.
yellow bells, Shorthills, N. J.
yellow lily, Ferrisburgh, Vt.
Hemerocallis fulva, L., Eve's thread, West Va.
Hyacinthus orientalis, L., Jacob's ladder, No. Ohio.
Lilium Canadense, L., meadow lily, nodding lily, N. Y.
Lilium Philadelphicum, L., tiger-lily, N. J.
glade-lily, West Va.
Lilium superbum, L., nodding lilies, Mass.
wild tiger-lily, Minn.
Maianthemum Canadense, Desf., wild lily-of-the-valley, Penobscot Co., Me.
bead ruby,[1] N. Y.
Melanthium Virginicum, L., bunch-flower, West Va.
Oakesia sessilifolia, Watson, wild oats, Penobscot Co., Me.
straw-lilies, Conn.
Polygonatum biflorum, Ell., conquer-John, Mo.
Smilacina racemosa, Desf., Job's tears, N. Y.
golden seal, Banner Elk, N. C.
Smilax rotundifolia, L., biscuit-plant,[2] Cape Ann, Mass.
horse-brier, Mass.
Streptopus amplexifolius, D. C., ***Streptopus roseus***, Michx., liver-berry,[3] St. Francis, Me.
Trillium, sp., moose-flowers, N. Y.
Trillium erectum, L., daffy-down-dilly, orange-blossom, Bradford, Vt.
squaw-flower,[4] Ferrisburgh, Vt.
birth-root, nosebleed, N. Y.
Trillium erythrocarpum, Michx., Sarah,[5] Penobscot Co., Me.
Trillium grandiflorum (?) Salisb., bath-flower,[6] Franklin Centre, P. Q.
Veratrum, sp., branch eliber,[7] Banner Elk, N. C.
Veratrum viride, Ait., poke-root, Franconia, N. H.
Yucca aloifolia, L., Spanish daggers, Ala.
Yucca angustifolia, Pursh, soap-weed, Iowa.
Zygadenus elegans, Pursh, alkali-grass, Minn.

[1] Probably from the beauty of the berries.

[2] Children eat the tendrils and new leaves.

[3] From the supposed medicinal value of the cathartic fruit, which is freely eaten by children wherever the Streptopus grows.

[4] Perhaps from the smell.

[5] *Trillium erectum* is here called Benjamin, and children every spring go hunting Benjamins and Sarahs.

[6] Evidently a corruption of beth-flower, which is in its turn derived from birth-flower, the Trilliums being quite generally known as birth-roots.

[7] Equivalent to branch hellebore, *i. e.*, the hellebore which grows along the brooks or "branches."

COMMELINACEÆ.

Tradescantia crassifolia (?) Cav., mother-of-thousands, Boston, Mass.
Tradescantia Virginica, L., spider lily, N. Y., New Orleans, La.

JUNCACEÆ.

Juncus, sp., sour-grass, Neb.
Juncus tenuis, Willd., poverty-grass, West Va.
wire-grass, Jones Co., Iowa.

ARACEÆ.

Acorus Calamus, L., calmus, N. J.
Arisæma triphyllum, Torr., wake-robin, Ferrisburgh, Vt.

ALISMACEÆ.

Sagittaria variabilis, Engelm., arrow-leaf, N. Y.

NAIADACEÆ.

Zostera marina, L., tiresome weed,[1] Little Egg Harbor, N. J.

CYPERACEÆ.

Carex, sp., nigger-wool,[2] Neb.
Cladium effusum, Torr., saw-grass, Fla., and other Southern States.
Cyperus strigosus, L., nut-grass,[3] Concord, Mass.
Eleocharis tenuis, Schultes, poverty-grass, kill-cow, West Va.
Scirpus lacustris, L., tule, Cal.
black rush, Minn.

GRAMINEÆ.[4]

Agropyrum glaucum, R. & S., slough-grass, pond-grass, Colorado blue-grass, blue-grass, S. W. Neb.
wheat-grass, Central Neb.
Agropyrum repens, Beauv., witch-grass,[5] Penobscot Co., Me.
Andropogon furcatus, Muhl., blue joint,[6] Minn.
Andropogon Hallii, Hackel, turkey-foot, W. Neb.
Andropogon scoparius, Michx., big blue stem, big blue joint,[7] Central Neb.

[1] From the obstruction which it offers to the oars of boats.
[2] From the blackish color of the leaves at the base.
[3] The tubers are eaten by children.
[4] For the names of most of the grasses given in this article, as well as for many notes upon them, the author is indebted to the kindness of Prof. C. E. Bessey.
[5] Never there known by any other name.
[6] In Maine *Calamagrostis Canadensis*, Beauv., is blue joint.
[7] In the western part of the plains this is one of the "bunch-grasses," and is often so-called.

Andropogon scoparius, broom-sedge, West Va.
Andropogon sorghum, Brat., Johnson-grass, So. Neb.
Aristida purpurea, Nutt., muskit grass, Tex.
Bouteloua hirsuta, Lag., black grama grass, Neb.[1]
Bouteloua oligostachya, Torr., blue grama grass, Neb.[1]
Bouteloua racemosa, L., tall grama grass, Neb.[1]
Bromus ciliatus, L., swamp chess, Neb.
Bromus ciliatus, var. *purgans*, Gray, swamp chess, N. W. Neb.
Bromus Kalmii, Gray, wild chess, Cent. and N. W. Neb.
Bromus Kalmii, var. *Porteri*, wild chess, N. W. Neb.
Bromus secalinus, L., chess or cheat, E., Central and N. Neb.
Buchloe dactyloides, Engelm., buffalo-grass, W. Neb.
Calamagrostis longifolia, Hook., sand-grass, Central Neb.
Cenchrus tribuloides, L., hedgehog-grass, West Va.
hedgehog-grass or bear-grass, Iowa.
Danthonia spicata, Beauv., June-grass,[2] Penobscot Co., Me.
Distichlis spicata, Greene, var. *stricta*, Thurber, salt-grass, N. W. Neb.
Eatonia obtusata, Gray, prairie-grass, Central Neb.
Eleusine Indica, Gærtn., dog's tail-grass, wire-grass, West Va.
Elymus arenarius, L., rancenria grass, Cal.
Eragrostis major, Host., stink-grass, Neb.
candy-grass, Central Neb.
Eragrostis tenuis, Gray, blow-out-grass,[3] Central Neb.
Festuca scabrella, Torr., bunch-grass, Cal.
Glyceria Canadensis, Trin., pearl-grass,[4] Waverley, Mass.
Holcus lanatus, L., old white top, feather-grass, velvet-grass, West Va.
Hordeum jubatum, L., squirrel-tail-grass, Neb.
Kœleria cristata, Pers., June grass, N. W. Neb., Central Neb.
Lolium perenne, L., English blue-grass, West Va.
Lolium temulentum, L., cheat, Berkeley, Cal.
Munroa squarrosa, Torr., false buffalo-grass,[5] Central Neb.
Panicum capillare, L., tickle-grass, West Va., Neb.
Panicum clandestinum, L., deer-tongue-grass, West Va.
Panicum sanguinale, L., pigeon-grass, Hopkinton, Iowa.
Panicum virgatum, L., switch-grass, wild red-top, E. Neb.
Paspalum undulatum, Poir., bull-grass, Ala.

Cambridge, Mass.

[1] In Nebraska the three species above given are often confounded. The word *grama* or *gramma* means grass, but in spite of tautology the word grass is usually added. By many farmers *B. oligostachya* and *B. hirsuta* are called buffalo-grass.

[2] Farmers call the dead grass in the spring, "old fog."

[3] A "blow-out" is a crater-like cavity in the side of a sand-hill. H. J. Webber.

[4] Name given by a few children, some years ago.

[5] So called because it looks like buffalo-grass, but is worthless.

The nature and distribution of attraction-spheres and centrosomes in vegetable cells.[1]

JOHN H. SCHAFFNER.

WITH PLATE XXXIII.

Introduction.

The question as to the nature of centrosomes and attraction-spheres and their importance in the cell is still in dispute. Some hold that these bodies are only temporary accumulations of the cytoplasm of the cell, while others contend that they are permanent organs, which are secondary in importance only to the nucleus itself. Moreover, the number of these bodies in each cell, their movements and manner of division, their action during impregnation of the ovum, whether they remain on the outside or inside of the resting nucleus, and even their action during the process of indirect cell division are all questions more or less in dispute. It seems, however, that from the chaos of opinions enough truth can be discovered to enable one to arrive at a safe conclusion in regard to many questions relating to them. Since the work hitherto done on plants was more especially in connection with reproductive cells, it was my purpose to work entirely with purely vegetative cells,—to study the existence of centrosomes and attraction-spheres in these cells, to find whether they remain on the outside of the resting nucleus or are included by the nuclear membrane, to determine the number of these bodies in each cell, and to trace them from the resting nucleus through the stages of karyokinesis. In my investigations, I had the assistance of Professor F. C. Newcombe, to whose suggestions are largely due whatever success I may have attained.

Historical.

Discovery.—To Professor E. van Beneden (26)[1] belongs the honor of having discovered the attraction-sphere. In the year 1887, he found in the fertilized ovum and the blastomeres of Ascaris megalocephala, at the poles of the nuclear spindle,

[1]Contribution from the Botanical Laboratory of the University of Michigan.
[1]The numbers refer to the bibliography at the close of the paper.

definite spheres each with a dense center, which he considered as permanent cell organs in connection with the nucleus. In the following year Boveri (1) observed the sphere and its center. He called the dense central body the centrosome, and regarded it as a contribution from the spermatozoon to the attraction-sphere of the ovum.

Distribution.—Investigations were made on various kinds of sexual cells until the year 1891, when Flemming (5) first found the attraction-spheres and centrosomes in the resting stages of leucocytes and in the epithelial cells of the lungs of the salamander. In the same year Guignard (10) demonstrated the existence of these bodies in reproductive vegetable cells, both in the resting stage and during karyokinesis. Since that time they have been found in the cells of many kinds of tissues, and especially in the ova of various animals.

Heidenhain (14) found them in the leucocytes of the salamander, in the medullary cells of the bones of young rabbits, and in the alveolar epithelium and leucocytes of the lung of a pneumonic patient; Bürger (3), in the proboscis-sheath of nemerteans, in resting cells; van der Stricht, (29) in the blastomeres of Triton and in the cartilaginous cells of several amphibia; E. de Wildeman (32), in Spirogyra and in the spore-mother-cells of Equisetum; Bütschli (4), in Surirella; and Schottländer (25), in the antheridia of Gymnogramme and in the spermatozoids and the ova of Chara. Heidenhain ($15\frac{1}{2}$) in a recent investigation has made a special study of centrosomes in the lymph cells (lymphocytes) and giant cells (megacaryocytes) from the bone marrow of the rabbit. He found them also in the spleen of the rabbit, and in the lymphatic gland and the wall of the intestine of the dog. Thus the bodies have been demonstrated in reproductive cells of both plants and animals, and also in non-reproductive animal cells.

General description.—The general appearance of a centrosome and its surrounding attraction-sphere is described by van Beneden (28) as a dense "cytocenter" around which may be distinguished a medullary and a cortical zone concentric to the central corpuscle. Heidenhain (15) also lays emphasis on the fact that the attraction-sphere is sharply limited from the surrounding protoplasm, and in many cases shows a distinct radiate structure. Guignard (10) says, in regard to the bodies seen by him in plant cells, that the attraction-spheres were composed of transparent granular areas in which the

centrosomes lay. Attraction-spheres and centrosomes vary in size in different kinds of cells. Flemming found them very small in the epithelial cells of the salamander's lungs, while in leucocytes they were much larger. Bütschli (4) says that the centrosomes, observed by him in Surirella, were so large that they were visible as a dark round granule even in the living cell.

There was a divergence of opinion, almost from the beginning, as to the number of these bodies in each cell. Many observers claimed that there was but one in the resting cell, and that this one divided before the nucleus began to divide; while others held that there were two to each resting nucleus, and that each of the two divided during nuclear division, so that each daughter nucleus was again provided with two. Flemming (5), in 1891, found the bodies double much more often than single, and he thought that where only one was seen the other might be hidden. Heidenhain (15), in 1892, stated that the number of centrosomes with each resting nucleus is always two. Guignard (10) also found them always double. Bürger, van Beneden, and van der Stricht evidently hold the opinion that there is only one. Thus there is room for doubt as to whether there may not be variation, in some tissues but one and in some two for each resting cell.

But Heidenhain ($15\frac{1}{2}$), in 1894, found in many cases along with the two centrosomes a third body, and sometimes a fourth, which he regards as an accessory centrosome (Nebenkörperchen). That is, he thinks that the accessory centrosome is nothing else than a centrosome of the smallest kind, which has its origin from one of the larger centrosomes. In the giant cells from the bone-marrow of the rabbit he found large numbers of centrosomes grouped together, sometimes as many as 135 in a group. There is generally one main group of these bodies in each cell, with one or more smaller accessory groups.

The bodies have been found quite universally in the same positions as regards the nucleus. In the resting cell they generally lie in a depression of the nucleus, close together, while during mitosis they are at the poles of the spindle. But Hansemann (12), while he holds that the centrosomes are permanent organs, believes with O. Hertwig (13) that they are in the nucleus during its resting stage and only come out in the first stages of division.

Activity and function.—According to Guignard (10), at the beginning of nuclear division spheres migrate to the poles of the future nuclear spindle and then each one divides during the prophase of nuclear division. But according to those who hold that there is only one attraction-sphere to the resting nucleus, the division takes place before the migration. Van der Stricht (29) finds that the division in the egg of Triton is, as a rule, effected in the quiescent stage of the nucleus, rarely during the anaphase, and exceptionally during the metaphase.

According to Heidenhain (15½) every centrosome arises from another one, not by self-division, but by budding, the largest centrosome in a group being the oldest, and the smallest the youngest.

The origin of the attraction-sphere and centrosome in the fertilized ovum does not seem as yet clearly worked out. As already stated, in the year 1888 Boveri advanced the opinion that the centrosome was brought into the attraction-sphere of the ovum along with the spermatozoon. But Guignard (10) found in the cells of the embryo-sac of Lilium Martagon that the attraction-sphere contained a centrosome before fertilization; so the hypothesis of Boveri must be given up. According to Guignard (11) there is a union of the attraction-spheres and their contained centrosomes accompanying the conjugating nucleus of the pollen-tube, with those of the nucleus of the embryo-sac during fertilization. He says that in angiosperms the two spheres brought with the male nucleus unite with the two of the female during the fusion of the two nuclei, leaving the new nucleus with two spheres, each composed of a male centrosome and its sphere united with similar bodies from the female.

Immediately, when van Beneden had made the discovery of attraction-spheres, he advanced an hypothesis as to their nature and distribution. According to van Beneden's hypothesis, there is in the cell outside of the nucleus a permanent cell organ—the attraction-sphere with its centrosome. This organ propagates itself by division when the cell does, but the division of the sphere precedes that of the cell. The rays of the spindle are attached to the sphere and are contractile fibers which attach themselves to the chromosomes and draw their halves towards the poles. The contractile rays of the spindle obtain a firm hold, for the spheres are held in place

by the cytoplasmic threads of the polar radiations. Thus an important part of the karyokinetic process would take place outside of the nucleus. Van Beneden also made the generalization that the spheres with their central bodies were of quite general distribution in both animal and vegetable cells.

Heidenhain (15½) considers that the attraction-sphere is not a constant characteristic of the cell but, as is the case in leucocytes, it is present only during the resting period of the cell, and not during the process of karyokinesis; thus the attraction-sphere is not considered to be an organ in the exact meaning of the word. He considers that the "microcentrum" (centrosome with its envelopes) of the higher organisms corresponds to the paranucleus of the protozoa while the nucleus corresponds to the macronucleus. He gives some important discussions on the physiological rôle of centrosomes and the law of their position, together with other theoretical views, but since they are beyond the scope of this paper they will not be considered here.

Bürger's (2) views are the following: He thinks that the bodies are not permanent organs, but that they are simply due to certain mechanical processes; that the central body is not the cause but the result of polar attraction. That is, he thinks the microsomes are attracted toward the center of the polar region from the periphery, and since they are solid bodies, if they are attracted equally from all sides, they form a hollow sphere which is the attraction-sphere.

Watase (31) has advanced an hypothesis somewhat similar. He thinks that the centrosome is simply a large microsome formed at the point where the greatest number of cytoplasmic filaments meet; that a barrel-shaped spindle possesses several independent microsomes at each pole instead of one centrosome. But this explanation, as well as that of Bürger, corresponds to so few of the observed facts that it seems entirely improbable. It surely could not be a reasonable explanation of the two bodies seen beside the resting nucleus by Guignard and others, nor the four spherical bodies, which can be so easily seen during metakinesis in cells of the ovary of Lilium and other plants.

For the filamentary structure of cytoplasm has not yet been demonstrated in plants; and if the centrosomes are only large microsomes, then the spindle must be divided into halves to produce the two centers at the poles, or else there must be a

crossing of filaments below the two centrosomes, neither of which has been observed.

If the views of those who hold van Beneden's hypothesis are correct, it becomes evident that every centrosome with its attraction-sphere must arise from a previous one, all the centrosomes in an organism arising from the primary one in the ovum, or according to the view of Guignard, from the two that are in the fertilized ovum, each of which represents the union of a male centrosome with one from the female. And thus they can be traced backward or forward from one generation to another the same as the nucleus.

The question naturally arises as to whether these bodies are present in cells which divide by amitosis, and if present what their action is during the process. Flemming (8) states that in leucocytes, where division is both direct and indirect, the "central bodies" are present; but they do not seem to be implicated in the fragmentation or direct division of the nucleus. He does not state what becomes of the spheres when fragmentation takes place, but concludes that only the products of karyokinetic division continue to live and multiply. Neves (19) has worked upon this subject with the spermatogonia of the salamander. He reports some discoveries, which, if they can be substantiated, truly present some very wonderful phenomena. He says that he saw the attraction-sphere become oblong, and that in various stages of the constriction of the nucleus the elongated attraction-sphere was twined in a ring about the constriction. In some cases the two ends of the elongated body appeared as though they were not yet fused together. When the division was complete, the elongated body appeared like a ring lying between but to one side of the two daughter nuclei; but there was only one of these bodies to the two nuclei. No further observations were made in regard to the subsequent action of the body and the two daughter nuclei; so the question of attraction-spheres in relation to amitotic division is yet in a very unsatisfactory state.

Plant cells especially.—The work hitherto done with plants is as follows: Guignard's investigations stand as one of the most important contributions to the subject. Guignard (10) found the attraction-spheres and centrosomes both in resting and dividing pollen-mother-cells of Lilium, Fritillaria, Listera, and Najas; in the mother-cells of the embryo-sac, with nuclei both at rest and in stages of division; in the cells of the

female apparatus derived from this nucleus; and in the endosperm. He found them in the microsporangium of Isoetes, and in the sporangium of Polypodium and of Asplenium. In his more extensive report (11) he adds many new and interesting facts, giving numerous illustrations of the appearance of these bodies in Lilium Martagon, Listera ovata, Lecojum vernum, and Galanthus nivalis. Bütschli found very large centrosomes in Surirella, a large form of diatom. E. de Wildeman (32) has found the attraction-spheres and centrosomes in Spirogyra jugalis and nitida, and in the spore-mother-cells of Equisetum, both in resting and division stages of the nucleus. Schottländer (25) claims to have found centrosomes in the male sexual cells of Marchantia polymorpha, but no attraction-spheres surrounding them. He found the attraction-spheres in the antheridia of Gymnogramme chrysophylla, and in the spermatozoids and the ova of Chara foetida. Thus in the reproductive cells of plants, and those directly concerned, the presence of attraction-spheres and centrosomes has been quite generally demonstrated, but has been reported in vegetative cells in but two cases.

Investigation.

The present work on centrosomes and attraction-spheres was begun in November, 1893. The growing tips of roots were principally used, though investigations were also made on other plant tissues. All of my material which needed sectioning was prepared according to the ordinary methods, by imbedding in paraffin and afterwards staining the sections on the slide; though I also did some staining *in toto*. After quite extensive experimenting, several methods were found of advantage in studying these bodies. Hermann's method, as given in Dr. A. Zimmermann's "Die botanische Mikrotechnik" 1892, was used very successfully on the root tips of *Allium cepa* L. The centrosomes are stained very black while the attraction-sphere is often quite clear, though sometimes somewhat stained by the safranin. The dark granular limiting layer is well defined, while the surrounding cytoplasm is red. The method is as follows: Fix the objects for one or two days in a solution of fifteen parts one per cent. platinum chloride, one part acetic acid, two to four parts two per cent. osmic acid, eighty parts water. Now wash the objects in flowing water, harden gradually in alcohol, and after that

place them from twelve to eighteen hours in pyroligneous acid. Next place the objects in a solution made of one part twenty per cent. hæmatoxylin, ninety-nine parts seventy per cent. alcohol. Keep in the dark and leave from twelve to eighteen hours, and after that in the dark for some time in seventy per cent. alcohol. Imbed and section. After the sections are fastened to the slide, cover them with a solution of potassium permanganate, which has so much water that it possesses a light rose color, and leave until they have an ocher color. Then wash the sections with a solution of one part hydric oxalate, one part potassic sulphate, 1,000–2,000 parts water. After this, stain the sections for three to five minutes in a saturated alcoholic (100%) solution of safranin; clear and mount in Canada balsam. I also prepared root tips in Flemming's fixing fluid, and after imbedding and sectioning, stained first with Kleinenberg's hæmatoxylin and then with a two per cent. aqueous solution of acid fuchsin. The ovaries and anthers of *Lilium longiflorum* Thunb., I stained in several ways. The centrosomes and attraction-sphere will be stained quite well, however, by simply leaving them for a considerable length of time in anilin-safranin, and then taking out the excess of color with alcohol. By another method I took equal parts of an aqueous (two per cent.) solution of acid fuchsin and acetic methyl-green, which in some cases made a very favorable stain.

The last method tried was one suggested to me by Professor Newcombe: (1) a one per cent. aqueous solution of ferrous sulphate, (2) a five per cent. aqueous solution of tannic acid, (3) anilin-safranin (one part of one per cent. alcoholic solution of safranin with two parts water), (4) an aqueous solution of picro-nigrosin, strong enough to have a dark bluish-green color. The slides holding the sections were placed thirty to forty-five minutes in the iron solution, then washed in water; next, the same length of time in the tannin, and washed again. Now the sections were covered again with the iron solution and left for a minute or two or until they changed to a rather dark color. After washing off the iron in a stream of water they were stained in the anilin-safranin from thirty minutes to one hour, and afterwards fifteen minutes or more in the picro-nigrosin. After raising them through the grades of alcohol and being careful so as not to take out too much of the safranin stain, they were mounted in balsam. The centrosomes were stained very dark and the attraction-spheres well

defined, often showing the radiate structure. Any of the above methods will give fairly good results with plant cells, if proper care is taken; but I prefer Hermann's method or the iron-tannin-safranin stain as giving the best results.

I found the bodies as a rule very small and used continually a Zeiss $\frac{1}{12}$ immersion lens, and generally a no. 8 compensating ocular. As a general rule, I think more difficulties are encountered in studying these bodies in plants than in animals. The killing fluids do not penetrate so readily, which causes more displacement and distortion of the elements of the cell. In the vegetable cell, moreover, are generally present large numbers of chromatophores, starch grains, crystalloids, and other such bodies, which may greatly interfere with the identification of such small bodies as centrosomes. In the root tips which I studied, I found the leucoplasts a constant source of trouble; and many stains which might otherwise be very useful become worthless because of the readiness with which they color these bodies. The radiate structure of the cytoplasm is also much less marked than in animal cells.

I found centrosomes and attraction-spheres in the following named material: in the young root tips of *Allium cepa* L. (figs. 1–11), in resting cells and the various stages of karyokinesis; in the root tips of *Vicia faba* L. (fig. 15); in the root tips of *Tradescantia rosea* L. (fig. 16); in the resting cells of the epidermis of the old bulb scales of *Allium cepa* L. (figs. 17 and 18); and in the epidermis of the anther (fig. 14) and the walls of the ovary of *Lilium longiflorum* Thunb. (figs. 12 and 13).

In the onion root tips, I was able to trace them through nearly all the stages of nuclear division (figs. 1–10) as well as in the young ovaries of Lilium. In the other material I did not trace them through the whole series, but in the Vicia and Tradescantia root tips I was able to see them in several of the stages of karyokinesis. In the epidermal cells of the lily anther, I found them quite common in cells that were completely in the resting stage (fig. 14); while in the epidermis of the onion scales, where all the nuclei were in the resting stage and where there is no subsequent cell-division, I also succeeded in demonstrating the existence of these bodies in many cases (figs. 17 and 18).

Whenever I observed the bodies in resting cells, there were always two centrosomes, each with an attraction-sphere, which was in most cases marked off from the surrounding cyto-

plasm by a well defined granular layer; and in cases where karyokinesis had advanced to any considerable extent, two centrosomes could be distinguished at each pole of the spindle. Sometimes there appeared to be but one at each pole, but careful focusing generally demonstrated the fact that one was lying below the other. In the root tips of Allium, where the division is tranverse to the axis of the root when one goes a little distance from the apex, the attraction-spheres always appear at the upper or lower end of the nucleus as seen in longitudinal section. In the resting cells, they generally lie quite close to the nucleus in a little indentation.

In the epidermis of the onion scales I observed these bodies in a sufficient number of cases to convince me that they were true attraction-spheres, since they had the same appearance and took the same stain as those which I saw by the side of the close skein of the daughter nucleus. Now in these epidermal cells of the onion scales the nuclei are all resting, and therefore the objection that the centrosomes may have just come out of the nucleus in the beginning of division cannot be made; and so I hold that the attraction-spheres with their centrosomes do not enter the nucleus during its resting stage but remain permanently outside of the nuclear membrane. Moreover, these cells of the epidermis of the bulb scales of Allium were all definitive resting cells; yet with the iron-tannin-safranin stain it was demonstrated that the centrosomes and attraction-spheres were still present beside the nucleus, and that they retained their usual structure.

When division of the nucleus takes place, I found the attraction-spheres in the onion roots at the very beginning of the close mother skein stage, one at the upper and one at the lower pole of the future spindle, still close to or in contact with the nucleus (fig. 2); and though I did not find any stage where one of the bodies had gone only part of the way around, yet there can be no doubt that one or both had traveled around from their original position to the poles. In the following stages the spheres elongate, and generally by the time when the nucleus has reached the loose mother skein (fig. 3) the centrosomes and their spheres have divided, though they still lie closer together than in the later stages. During metakinesis and the daughter star stage (figs. 5–7), they can be seen very distinctly at each pole; and they keep this position in relation with the nucleus through all the suc-

ceeding stages of the division (figs. 8–10), and through the resting stage of the nucleus until a new division of the nucleus takes place.

It will be seen from the fact that the centrosomes remain at the position of the pole of the daughter nucleus until the division following, that in the case where the next spindle is in the same direction as the preceding one, one of the centrosomes must travel through 180° to come to the opposite pole of the nucleus. But in the case where the division is at right angles to the preceding one, each centrosome must travel through 45° in order to reach the poles of the future spindle. Now in the Allium root tips, in many cases, in a given chain of cells, division will take place logitudinally at a certain distance from the apex; and from that point onward there will be two chains of cells instead of one, and farther on the division of the nucleus will again be in a plane transverse to the axis of the root. Thus taking such an example where the cell has divided transversely, if the next division is longitudinal each centrosome must pass through 45°; the next division being transverse again both bodies must again travel as before; but in the third division one of the bodies will be stationary while the other passes through 180°. In a strand of cells coming from the apex of the root, the cells as they continue to divide always maintain a curve, and the attraction-spheres will not be quite 180° apart as they lie at the two poles of a dividing nucleus. I have observed in cells at these points, that the spheres lay inclined with the daughter nucleus toward the concave side of the strand of cells. The bodies do not always travel in the same direction, as will readily be seen when we take into consideration a strand of cells from an onion root whose elements are dividing transversely. If the spheres are at the proximal end of the nucleus when division occurs, the migrating one will travel in a direction toward the apex of the root; but if they lie at the distal side of the nucleus it must travel in the opposite direction. The whole subject shows that the centrosomes with their spheres travel in a very complicated manner during the formation of any given vegetable tissue.

A very peculiar phenomenon was noticed in the root tips of Allium. In many cases the spindle was formed obliquely in the cell, the attraction spheres lying near opposite corners of the cell as it appeared in longitudinal section (fig. 11).

The actual length of the spindle from pole to pole was greater than the length of the cell. It appeared as though there was not enough room for the division of the nucleus, and the bodies had wandered to the corners in order to gain more space for the formation of the spindle. It seems to me that this phenomenon explains itself if we admit that the attraction-spheres are directive in their function, and control nuclear division; but the appearance might be just as well accounted for by supposing that the controlling power rested in the nucleus or the cytoplasm of the cell in general.

Results.

The special results of the investigation are as follows:

1. Centrosomes aud attraction-spheres are present in non-reproductive as well as reproductive vegetable cells.
2. They remain on the outside of the nucleus during its resting stage.
3. They persist in cells which have ended their growth and division.

Besides the foregoing results, the present investigation furnishes confirmation to the following propositions:

1. In phanerogams there are two of these bodies for each resting nucleus.
2. When the nucleus begins to divide, one or both of the bodies migrate so as to take their positions at the poles of the future spindle.
3. Subsequently they immediately begin to divide, the division being completed in the prophase of the mother nucleus.
4. After their migration, the attraction-spheres remain at the poles of the nuclear spindle, and do not change their position until the beginning of the following division.
5. They seem to be organs which institute and direct nuclear division.

Summary.

The theory advanced by Van Beneden has received the support of many of the leading biologists, and has with some additions been quite generally substantiated by investigations. Taking the facts and opinions of those who have studied these bodies, into general consideration, the subject seems to be in the following condition: There is a permanent body in the

cell—the attraction-sphere with a centrosome—which is of universal distribution in both plants and animals—at least in all cells which divide by karyokinesis. This body propagates itself by division. As a rule, there seem to be two of these bodies for each resting nucleus, but in some cases only one. They remain constantly ouside of the nucleus. They appear to be the organs which direct nuclear division. It seems that there is a union of the attraction-spheres and centrosomes accompanying the male nucleus with those of the female nucleus during impregnation of the ovum. The bodies migrate and divide, and are thus carried from one cell to the other throughout the entire organism, whether plant or animal.

Ann Arbor, Mich., June, 1894.

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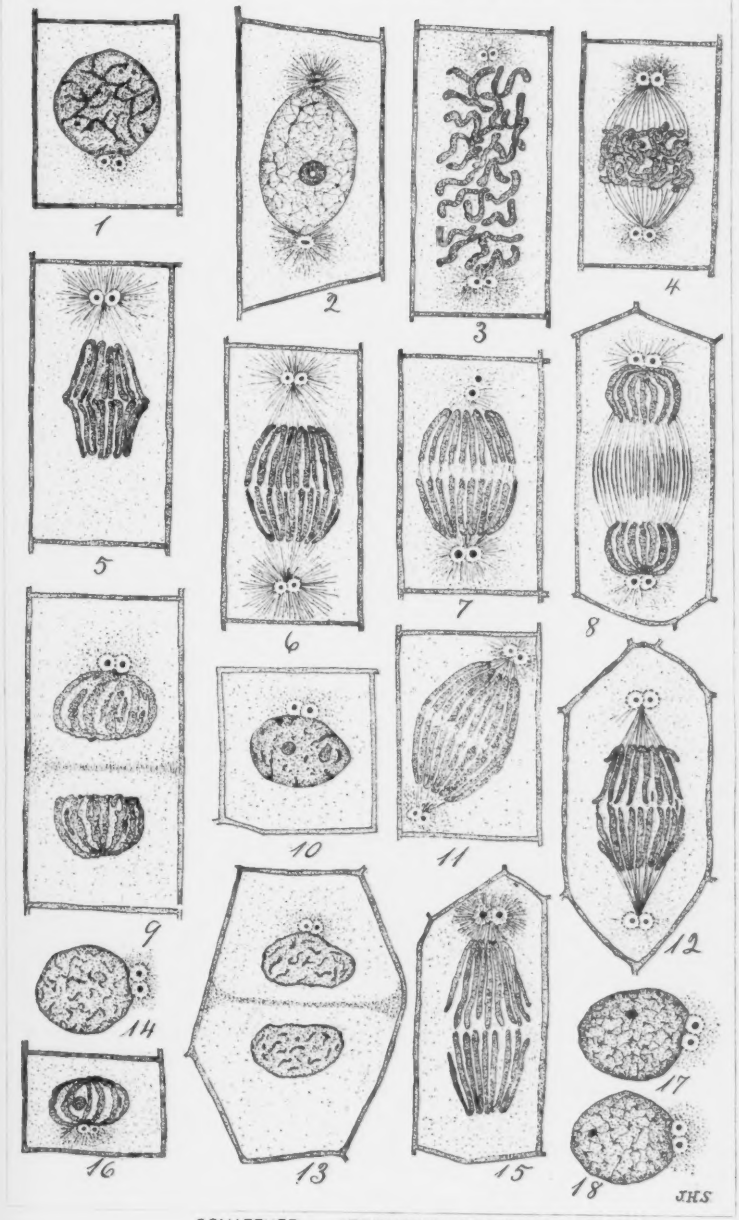
Explanation of Plate XXXIII.

Figs. 1–11, *Allium cepa*—root tips.

Fig. 1. Resting nucleus, showing two attraction-spheres with centrosomes.—Fig. 2. Beginning stage of division, one attraction-sphere being at e ch pole. The centrosomes are slightly elongated.—Fig. 3. Loose mother skein; the attraction-spheres have completely divided —Fig. 4. Formation of the nuclear spindle; the attraction-spheres and centrosomes lie at the poles.—Fig. 5. Metakinesis; the bodies were seen only at one end of the spindle.—Fig. 6. Metakinesis farther advanced; the attraction-spheres with their centrosomes appear at each pole of the spindle, and are surrounded by the cytoplasmic radiations. —Fig. 7. Daughter star; at the upper end of the spindle one of the centrosomes is displaced.—Fig. 8. Loose daughter skein, showing the four attraction-spheres.—Fig. 9. Close daughter skein, only the upper nucleus showing the bodies.—Fig. 10. Daughter nucleus nearly complete. The nuclear membrane



SCHAFFNER on ATTRACTION-SPHERES.

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has appeared. The two centrosomes with their spheres appear at the upper side.—Fig. 11. A cell in which the spindle lies obliquely.

Figs. 12–14, *Lilium longiflorum.*

Fig. 12. Last stage of metakinesis, showing the attraction-spheres and centrosomes, with cytoplasmic radiations around the poles. (From wall of young ovary.)—Fig. 13. Last stage of close daughter skein; the upper daughter nucleus shows attraction-spheres and centrosomes. (From wall of ovary.)—Fig. 14. Resting nucleus from the epidermis of the anther, with two attraction-spheres.

Fig. 15. *Vicia faba*—root tips. Daughter star; showing two centrosomes with attraction-spheres at the upper end of the spindle.

Fig. 16. *Tradescantia rosea*—root tips. Close daughter skein; the centrosomes with spheres appear at the lower side.

Fig. 17. *Allium cepa*—epidermis of bulb scales. Resting nucleus with two attraction-spheres and centrosomes.—Fig. 18, similar to fig. 17.

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Notes on dédoublement.

AUG. F. FOERSTE.

Trillium sessile. Three interesting cases of more or less quaternate structure in this species of Trillium have recently come under our observation. One of these is quite simple in character. First came a pair of opposite broader leaves, followed in decussating order by a pair of narrower leaves, an outer pair of sepals, an inner pair of sepals, then by a set of four petals decussating with the two sets of sepals taken as a whole, next by four outer stamens, these by four inner stamens, but of practically similar insertion, and lastly by an ovary which bore four distinct styles.

Mr. Ed. Rynærson, teacher of botany at the Dayton High School, found a vastly more interesting case which he placed at the writer's disposal. To appreciate this fully it must be remembered that the sepals of this species are green and the principal veins are longitudinal and parallel, while the petals are dull purple brown in color and have veins which incline towards either side of the petals and show more or less of an anastomosing structure. First there is a pair of opposite leaves (fig. 1), next a pair of slightly narrower leaves. With these four leaves as a whole, the sepals if there be four acting together as a whorl should decussate. And with these four sepals four petals should decussate. To determine how a plant with only six floral envelopes could manifest this tendency might puzzle a mathematician, but the question has been solved by this curious plant in a very odd manner.

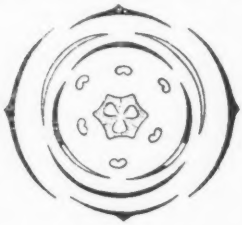


Fig. 1.

On either side of one of the second pair of leaves is found a sepal in decussating position. On either side of the opposite leaf is found a floral envelope in position a petal but in appearance partly petal and partly sepal. One of these is colored and veined like a petal on the outer half, and colored and veined like a sepel on the inner half, so that this inner half falls in the proper space to represent a third sepal. The other floral envelope is colored and veined like a petal on the

outer half; the strip along the inner half of the petal for about a quarter of the width of the floral leaf is green and parallel veined like a sepal, but the quarter strip on the inner edge of this floral leaf is again colored and veined like a petal. The result is that these two floral envelopes, petals in position on a ternate arrangement, show sepal character along their inner halves, where the other pair of sepals should be on a quaternate plan.

To complete the analogy that third floral envelope on a ternate plan which should be a sepal, shows all the characters, both in color and venation, of a petal. Opposite to this between the two undoubted sepals is found the regular petal. On either side, to complete the quaternate whorl, would then come those halves of the peculiar floral envelopes described above, which are colored and veined like petals. The purple color and anastomosing veins on the other side of the purple strip can not destroy this analogy, but only add to the interest of the case. The tendency towards quaternate structure induced by the four leaves is therefore shown by the coloring and venation of the floral envelopes, while the return to the ordinary ternate structure is heralded by the actual number of floral envelopes (6) produced. There are six stamens and three styles.

In a third case, also found by Mr. Ed. Rynærson are found two leaves (fig. 2), followed by two other leaves; decussating with these are four sepals; almost decussating with those at three places are three petals, heralding the return to the ternate type, and at the place where the fourth petal ought to be, two stamens are found, attached by their filaments below, of which that stamen which should according to the quaternate plan be the fourth petal has a somewhat broader filament. Not counting this half of the compound stamen, there would be six stamens, following the three petals in regular ternate order. Including that half of the stamen there would be seven stamens, but with that interpretation, if viewed only as an ordinary stamen, there would be no logical explanation of the sequence of the floral leaves, or of the presence of the seventh stamen. There are three styles.

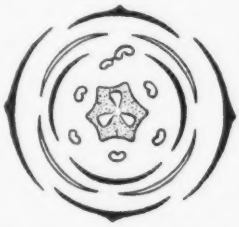


Fig. 2.

Nothing could be more interesting from the point of view of phyllotaxy than this attempt of plants to maintain a quaternate phyllotaxy, after numerically they had gone over to the normal ternate plan.

A fourth case, also found by Mr. Rynærson, has three ordinary leaves in ternate order (fig. 3). There are two ordinary sepals, and the third one has been replaced by a green leaf of about one-half the ordinary size, but divided almost to the very base, the venation of each half near the base being obliquely outward as when forming part of an entire leaf. The result is that the two divisions of the leaf-like sepal and the two ordinary sepals take up a position which is ternate to a certain extent and decussate with reference to the normal leaves, but more quaternate when considered among themselves. It is impossible to reproduce this effect satisfactorily in a diagram. Decussating with this set should come four petals if the quaternate plan is to be carried out. The fact is that the petals do decussate, but there being only three petals, this leaves one space vacant. Next on the quaternate plan there should be four stamens, one above each of the two normal sepals, and one above each division of the leaf like sepal. These are present. Next should be found four stamens, one over each of the petals present, and one over the space left vacant in the row of petals; but the last one does not occur, thus showing a return to the ternate order numerically but not necessarily in position. Finally, if the quaternate arrangement is to hold, one style should appear over each of the outer (four) stamens. These occur, but one of them is smaller and its cell is narrower than in the rest. The numerical order is therefore three, four, three, four, three, four, the quaternate *position*, however, being maintained, even where the actual number of parts had gone back to the ordinary arrangement in threes.

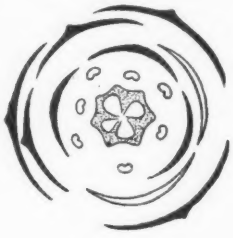


Fig. 3.

Ulmus. Mr. W. B. Werthner, teacher in the High School here and an expert botanist, found this spring on McDaniel St. a very interesting set of cases of dédoublement of leaves which seemed to be quite common in the young vigorous elms along

the sidewalk. He very kindly placed this material at the disposal of the writer. The trees had recently been pruned, and the material in question consisted of the twigs which had fallen into the street. It being early spring, only the leaf-scars remained to indicate the fallen leaves, but the scaly leaf buds were well shown. We will use the term leaves instead of leaf-scars.

In the most interesting case the third node above the cut end of the twig showed a bud in the axil of the leaf, and a smaller one in the axil of the lower stipule. Two leaves, each subtending a bud, occur after intervals of six, four, seven, six, and again of six nodes, in the last case the pair appearing just beside the terminal scar. There is here a sort of tendency towards the recurrence of dédoublement after an interval of about six nodes.

On a second twig, one of the lowest nodes shows also a bud in the axil of a leaf and a second smaller bud in the axil of the lower stipule. At the fourth succeeding node the leaves are opposite and do not maintain the usual lateral position of the one half phyllotaxy, the pair having a diagonal position. Above this point every alternate leaf is separated by a shorter internode from the leaf below, so that the leaves have an evident tendency to form decussating pairs. First are found three pairs, of which the leaves are separated by shorter internodes, then one pair of which the leaves are opposite, next a pair of which the leaves are separated by shorter internodes, and finally at the tip of the stem, a pair of leaves which are opposite, and on each side of the terminal scar. The tendency to form decussating pairs is here very marked, and is fully successful at irregular intervals.

In a third case, two leaves, each subtending a bud, occur at the fifth node from the cut end, and also at the fourth succeeding node. Then two buds occur separated by shorter internodes, and next are found two leaves subtending a single bud placed in their conjoint axil. At the second axil above this two leaves each subtending a bud occur. Then come two buds separated by shorter intervals, and next two leaves, with two buds, of which one is larger. After this come five buds presenting a sort of two-fifths phyllotaxy.

On a fourth twig the second node bears two leaves subtending as a pair but a single bud. At the second node above are two leaves each subtending a bud; this recurs at the fifth suc-

ceeding node, and is followed by two leaves separated by a shorter internode, and then by two which are almost opposite, and these in turn by two leaves at the same node, each subtending a bud. The pairs of the whole series decussate after a fashion. At the third node above occur two leaves, as a pair subtending a single bud. At the second succeeding node are two leaves each with a bud, and then follow six or seven buds, as far as the tip of the twig.

On a fifth twig two leaves, as a pair subtending a single bud, are followed in the same vertical plane by two opposite leaves and buds, and these by a similar pair in decussating position. Next follow ten leaves in a sort of spiral phyllotaxy, the alternate leaves being separated by shorter and shorter internodes on going higher up on the twig, so that the ninth and tenth leaves are again almost opposite. Then the phyllotaxy becomes spiral again. A branch growing from this twig shows at one node a bud in the axil of a leaf and a second bud in the axil of a stipule.

As a series these twigs show a tendency to recurrence of the abnormal phyllotaxy even after a more or less successful return to normal conditions. The presence of two leaves (or rather leaf-scars) subtending a single bud, and occasionally of a bud also in the axil of a stipule, is especially interesting.

Arisæma triphyllum. Marion Nichols, one of the pupils of the High School, brought in a remarkable case of dédoublement in the Indian turnip. Two leaves have developed on the same petiole. The petioles coalesce perfectly below, but show an impressed line in front and in the rear towards the top. The middle leaflet of each leaf is of course distinct; so are also the two inner leaflets of each leaf. On the contrary, the two outer leaflets, which one might expect to be farthest removed, have grown together along their midribs, but are free elsewhere. In the axil of this double leaf is a double flowering stem also coalesced perfectly below but bearing an impressed line above, and bearing on each side a "flower," both spathes being well developed but placed back to back, the open ends therefore facing away from each other. The spadix in each case bore only ovaries. It will be seen at once that this is a case similar to many of those mentioned in the case of the elms, where by dédoublement two leaves appeared at one node, and each leaf bore a bud in its axil, only in the case of the Indian turnip the dédoublement has not gone to the extent of perfect separation of the parts.

Podophyllum peltatum. The numerical floral plan given by Eichler in his Blüthendiagramme, **2**: 137, based upon the work of Payer and Baillon, assumes a ternary arrangement of the stamens, of which the outer circle contains *three stamens*, and the inner *nine stamens in three groups* of three stamens each, each group being considered a single but compound stamen. That this is not a correct interpretation can be readily seen by one having access to abundant fresh material. The typical plan is undoubtedly ternate (fig. 4). As is well known from aberrant occurrences and from other species, the leaves are not truly opposite, but alternate, the terminal flower having on this account the appearance of appearing higher up on the side of one of the petioles. This fact has been emphasized in the diagrams. The three bracts and six sepals are introduced in accordance with the interpretation of Asa Gray, which accords with the general ternate structure of the petals and stamens. The position and number of the petals and stamens and of the placenta of the ovary are taken from an occurrence actually at hand at the time the drawing was prepared. There are evidently three petals, with which decussate three more petals, and with these as a whole decussate first six stamens, and then again six stamens. Nothing can be more improbable than the peculiar occurrences of ternary dédoublement assumed by these distinguished authors.

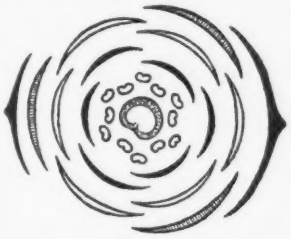


Fig. 4.

Dayton, Ohio.

BRIEFER ARTICLES.

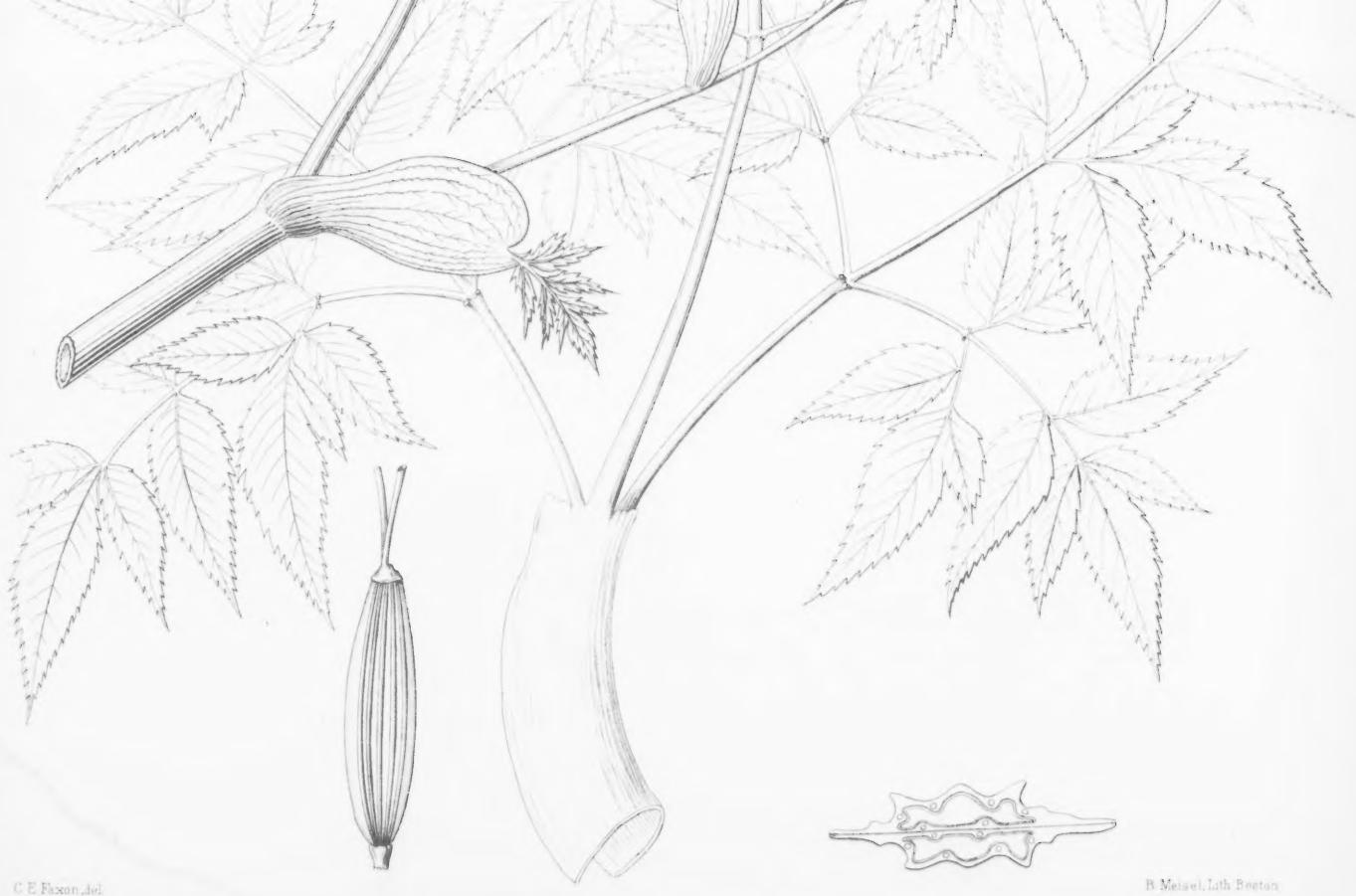
New genus of Umbelliferæ.—WITH PLATE XXXII.—Mr. John Donnell Smith has recently sent us from his last collection in Central America a new genus of Umbelliferæ. This is a most peculiar plant, not closely related to any known genus, nor is it easily referred to any tribe. It becomes a small tree fifteen feet high and is the only arborescent species which we have seen from North America. Only two plants were seen, growing at an altitude of 10,200^{ft} and constituting the highest vegetation on the volcano.

This is the third genus of Umbelliferæ that has been brought to light by Mr. Smith in Central America. We have previously reported upon Guatemalan Umbelliferæ in this journal for January and October, 1890, and February, 1893.

Myrrhidendron, genus nov.—Calyx teeth obsolete. Fruit linear, flattened dorsally, glabrous, shining. Carpels strongly flattened dorsally; dorsal and intermediate ribs low; lateral ribs narrow-winged. Stylopodium low conical. Oil-tubes solitary in the intervals, two on the commissural side. Seed strongly flattened dorsally, with a flat face and furrowed under the oil-tubes.—Arborescent. Leaves large, decompound; leaflets ovate. Flowers white.

A peculiar genus, with fruit of the shape and texture of *Myrrhis* but differently flattened. The carpels are flattened as in *Peucedaneæ* but in other respects unlike that tribe.

Myrrhidendron Donnellsmithii sp. nov.—A small tree 3.6 to 4.8^{m} high; trunk 7.5^{cm} in diameter: leaves large, 30^{cm} or more long, ternately compound; leaflets ovate to lanceolate, 2.5 to 5.0^{cm} long, acute, sharply and often irregularly serrate, the teeth more or less mucronate-tipped, glabrous, shining and impressed veiny above, dull and paler beneath and conspicuously reticulate; petiolules with a prominent stipular ring which is more or less glandular tufted; petioles large, inflated: peduncles short: involucre few-leaved; involucels numerous, 3- to 4-toothed or cleft near the apex, scarious margined and strongly purplish veined: inflorescence more or less glandular puberulent; rays numerous, rarely equal; pedicels 8 to 10^{mm} long: fruit linear, 10 to 12^{mm} long, glabrous.—From the lava beds at the summit of the volcano Irazii in the province of Cartago, Costa Rica, March, 1894 (no. 4,825).—JOHN M. COULTER and J. N. ROSE, *Lake Forest, Ill.*, and *Washington, D. C.*



C E Faxon, del.

B Meisel, Lith Boston

MYRRHIDENDRON DONNELLSMITHII Coult. & Rose.

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Completoria complens Lohde.—This very interesting parasite of fern prothallia has not, heretofore, I believe, been reported as occurring in the United States. It was found by me last winter in fern prothallia grown in the Botanical Conservatory of Cornell University. The fungus is very interesting both from its relationship with the *Entomophthoræ* and from its being a parasite in plants. It is of very simple structure.

The germinating conidia do not enter the cells of the prothallia directly, but put out a short germ tube which enlarges at its end, and into this enlarged end the protoplasm migrates, thus forming a germinating vesicle or proembryo. From this germinating vesicle the tube arises which penetrates the cell of the prothallium. The cell wall forms a sheath around the entering tube and the wall here becomes reddish brown. The tube, which is quite slender, grows directly to the center of the cell lumen where it enlarges into a flask-shaped body, rich in protoplasm, very granular, and with large vacuoles. From this a short and thick branch grows out and curves more or less closely to the parent cell or hyphal body. Successive branches of a similar kind arise and curving around form a closely compacted botryose cluster, which eventually more or less completely fills the cell lumen. From the marginal cells of this cluster slender tubes arise which penetrate into the adjacent cells. Conidia and sexless (?) resting spores are formed.

In the formation of the conidia certain of the marginal cells of the botryose cluster grow through the wall of the prothallium cell to the exterior, where a single-spored sporangium is formed, either quite close to the surface of the prothallium when the conodiophore is very short, or at a little distance from it when it is longer. The conidium is thrown off with considerable force as in the other *Entomophthoræ*, and the basal end protrudes slightly as a prominent point. If the conidia are not in a favorable position for entering the cells of a prothallium, or the surrounding conditions are unsuitable for it, it may produce a short conidiophore and a secondary conidium be thrown off. This may quite likely be repeated several times.

The resting spores are formed from the central cells of the botryose cluster, and may vary in a single cell of the prothallium, and thus in a single cluster, from one to ten or fifteen. These cells become larger than the others, gradually round off, the protoplasm contracts somewhat and at the same time the wall thickens inward. The appearance of many of the outer cells in such a cluster suggests the possibility of there being a sexual process, but in no case have I seen any communication between these cells, although I have carefully examined

many. This however may have been overlooked because of the difficulty of observation in such a large mass of cells.

The fungus was found in prothallia of *Aspidium falcatum*, *Pteris argyria*, and *P. cretica*.

It was first described by Lohde.[1] Subsequently Leitgeb[2] made it the subject of a thorough investigation, and grew it in a large number of species of fern prothallia.—GEO. F. ATKINSON, *Ithaca, N. Y.*

Lemna Valdiviana in Massachusetts.—Several interesting botanical excursions have been made this year in the lands recently set apart by the state of Massachusetts for public parks.

By notice sent out by the superintendent of planting for the parks, the local botanists have had the opportunity of enjoying a series of pleasant field days and comparing the work done in different portions of the reservations.

One such trip was taken on Sept. 3d through the Blue Hills region, eight miles south of Boston. This public park is thirteen miles in circumference and includes the highest land in eastern Massachusetts (Blue Hill, 636ft), as it is also the highest land on the Atlantic coast from southern Maine to Florida. It has long been locally famous for its rocky ledges, basin-like swamps, and, on its southern side, the extensive meadows and ponds of two sorts, rocky, with clear waters, and marshy, with dark waters.

The most interesting find on that occasion was a Lemna, which, so far as comparison with specimens at the Gray Herbarium shows, is *Lemna Valdiviana* Philippi; and I send this note of its occurrence so far north of its usual habitat, and would be very glad to have some southern or western *L. Valdiviana* in exchange.—GEO. G. KENNEDY, *Readville, Mass.*

Puccinia malvacearum.—Some years ago, the late Geo. W. Clinton of Buffalo, N. Y., expressed himself as disappointed because a certain Ranunculus did not turn out to be R. bulbosus. "Why can't Buffalo have this plant?"

We have rather desired at this place the presence of living Puccinia malvacearum, because it was so useful for the class room. This year, for the first time, it has been introduced with some hollyhocks purchased at the east. It has already made serious attacks on half a dozen species of plants in our botanic garden and now that we have it, the thing doesn't seem so funny.—W. J. BEAL, *Agricultural College, Mich.*

[1] Tagblatt der Naturforscherversammlung zu Breslau, 1874.

[2] Sitzungsbericht der Math.-Naturwiss. Classe d. kaiserliche Akademie der Wissenschaft. Wien **84**[1]: 288. 1881.

CURRENT LITERATURE.

The Flora of Nebraska.[1]

The members of the botanical seminar of the University of Nebraska have undertaken not only a botanical survey of the state, but have begun the publication of a flora on an elaborate and costly plan. The first two parts of the twenty-five promised have recently been issued and are an earnest of a most admirable work. The brief introduction prepared by Dr. C. E. Bessey (who, we doubt not, is the inspiration of the undertaking) gives an account of the principles of classification of the vegetable kingdom. The first part, embracing sixty-eight pages and twenty-two plates has been prepared chiefly by Mr. De Alton Saunders, who describes the green plants belonging to the Protophyta and Phycophyta; while Messrs. Roscoe Pound and Frederick R. Clements describe the fungi of these groups. The second part, on the Coleochaetaceæ and Characeæ, has been done by Mr. Albert F. Woods, and consists of nine pages of text with fourteen plates.

Of the accuracy of this work only a specialist can judge and we do not undertake to pronounce upon it; but however many slips there may be, or however crude the critical work may be, it can hardly be doubted that the publication will be of great value in making known the flora of the state not only to those outside it but much more to those inside it. That it begins with the plants it does (or even treats them at all) will be a revelation to many a teacher, who thinks of these as plants to be sure, but hardly as plants which can be described, much less identified, by ordinary mortals.

A word of commendation should be said for the plates. The drawing, engraving and printing are all excellent and they contribute much to the value of the work. Not all the species are represented of course. No principle of selection is stated and we are unable to discover what it is beyond that of figuring at least one species of each genus. So many of the species are thus shown that the plates add immensely to the helpfulness of the text.

Nebraska is in peculiar need of a local flora, since it lies at the junction of the Rocky Mountain and prairie region, and even the published

[1]Flora of Nebraska. Edited by the members of the botanical seminar of the University of Nebraska. 4to. Introduction, by Charles E. Bessey. Part 1, Protophyta-Phycophyta, by De Alton Saunders, pp. 1-68. pl. 1-22. Part 2, Coleochætaceæ, Characeæ, by Albert F. Woods, pp. 119-128. pl. 23-36. Lincoln, Neb. Published by the Seminar. 1894. Per part, $1.00.

floras of the spermaphytes do not adequately cover its territory, to say nothing of the entire lack of manuals for the lower plants.

We congratulate the people of Nebraska therefore, on the auspicious beginning of this work. We commend the disinterested labors of the botanical seminar to public support by the appropriation of public moneys for maintenance and extension of the botanical survey. No state, so far as we are aware, has ever had such work done at private cost, and we doubt not that a small appropriation would not only greatly encourage these unselfish students of the Nebraska flora, but greatly facilitate and extend their work.

Minor Notices.

PROF. W. W. BAILEY'S Botanical Note Book will surely be welcomed by those who intend giving a course of lectures on structural and systematic botany in relation to the phanerogams, and conducting classes in laboratory work in the same subject. The book is divided into two parts. The first part consisting of outlines of lectures on the seed, root, stem, leaves, inflorescence, flower, essential organs, and fruit. Each lecture is followed by a schedule for the description of the parts treated in the lecture.

The schedules consist of questions, and lines of investigation to be followed by the student. Part two is devoted to lectures upon certain difficult families or genera with schedules for their study. These are arranged in the same general way as the preceding, and include Compositæ, Umbelliferæ, Cruciferæ, Gramineæ and Ferns (with the genera Carex and Cyperus.) The framework of an introductory lecture on the subject of botany in general precedes the whole. The book is of handy size, 6¾ by 4½[in], and is bound in strong flexible covers. It will be a welcome addition to the laboratory, and a practical help to the instructor.—WALTER DEANE.

THE PROCEEDINGS of the Indiana Academy of Science for 1893 contain much botanical material, chiefly in connection with the work of the State Biological Survey. Professor Underwood, the botanical director of the survey, gives an account of the work, followed by a complete bibliography of Indiana botany, a list of cryptogams at present known to inhabit the state of Indiana (about 650), containing descriptions of some new species, and complete lists of hosts in the case of parasites. Among the botanical papers published in full are a general consideration of the phanerogamic flora of the state, by Stanley Coul-

[1] BAILEY, W. W.—Botanical Note Book. A synopsis of lectures and laboratory plans for use in Brown University and University Extension classes. Providence, R. I. Preston and Rounds, 1894.

ter; the special senses of plants, a presidential address by Dr. J. C. Arthur; notes on Saprolegnia ferox, by Geo. L. Roberts; the ash of trees, by Professor M. B. Thomas; our present knowledge of the distribution of pteridophytes in Indiana, by Dr. Underwood; the adventitious plants of Fayette county, by Robert Hessler.

RACIBORSKI has studied the morphology and development of the shoots and flowers of the Cabombeæ and Nymphæaceæ. His results appear in *Flora*, 78: 244–279. 1894, and his paper has been distributed also as a separate, *repaged*. The editor of *Flora* ought not to permit this, even if the publisher knows no better than to do it. When will such bibliographical sins cease?

THE DEPARTMENT of botany of the British Museum has had prepared a "Guide" to Sowerby's models of British fungi now in the possession of the Museum. All the species are described and many figures are given. The guide forms a brief compend of the larger and more common edible and poisonous fungi of Britain.

MR. EDWARD A. BURT has worked out the histology and development of a new species of the imperfectly known phalloid genus Anthurus, *A. borealis* Burt. He characterizes the species, and describes his investigation in the *Memoirs* of the Boston Society of Natural History, 3: 487–505. *pl. 49, 50.* O 1894.

ANOTHER of the useful keys to Manhattan (Kans.) plants, by Professor Hitchcock, has appeared. This one is based upon fruit characters, and will be found valuable for winter study.

NOTES AND NEWS.

DR. H. MOLISCH has been called to the German University at Prag as professor of anatomy and physiology of plants and director of the physiological institute.

THE DEPARTMENT OF AGRICULTURE has issued a bulletin on "nut grass" (Cyperus rotundus), regarding which Mr. Dewey, assistant botanist, desires information.

THE ACADEMY OF SCIENCES at Berlin has appropriated 500 marks for the prosecution of the work of the International Commission for the reform of botanical nomenclature.

DR. EDWARD PALMER has gone to Acapulco, Mexico, where he expects to make a collection of plants. He goes at his own expense, but his plants will be named as heretofore by Mr. J. N. Rose of the Department of Agriculture.

IN THE *American Naturalist* (August) Professor L. H. Bailey publishes a paper on "Neo-Lamarckism and Neo-Darwinism," in which these varying schools are defined, and exceptions taken to Weismann's theory of the continuity of the germ-plasm, as well as his sweeping claims concerning acquired characters.

IN THE *Zeitschrift für Pflanzenkrankheiten* 4: 5. 1894, Jacob Eriksson and Ernst Henning describe a new Puccinia (*P. dispersa* Eriks. & Henn.), from Sweden. The æcidium stage is found upon two species of Anchusa. The uredo and puccinia stages occur on at least eleven species of Gramineæ, including several of the cereals.—L. S. C.

DR. HARSHBERGER'S note (p. 159) concerning *Ranunculus acris* L. as being poisonous tells an old story. In many places, beggars used to rub their hands with this plant, in order to make them sore and thus obtain alms. For this reason the Danish name of the plant is Tigger-Ranunkel (beggar-r.). The Kräutterbücher and old floras know a great deal about this plant.—J. C. BAY.

IN THE October number of *Forstlich-naturwissenchaftliche Zeitschrift* appears the concluding part of "Contributions to the history of development of buds in some deciduous trees," by Dr. Paul Albert; "Investigation of the morphology and anatomy of malformations upon shoots and leaves caused by the Exoasci," by W. G. Smith; and "The capacity of oak stumps for budding, and their infection by *Agaricus melleus*," by Dr. Robert Hartig.

MESSRS. Frank S. Collins, William A. Setchell, and Isaac Holden have made preparations for the issuing of sets of dried specimens of the North American algæ, both of the fresh and of the salt waters, for the aid of investigators, and to assist in the development of a better knowledge of the North American species. Contributions of sets of eighty specimens each are solicited. All interested are requested to address Frank S. Collins, 97 Dexter St., Malden, Mass.

THE BELGIAN ACADEMY of Sciences at Brussels has offered prizes tothe value of 600 francs for the best treatise on the following themes:

(1) Researches on the number of chromosomes before fertilization in any animal or plant; (2) New researches on the quaternary flora (of Belgium) and especially on the peat bogs; (3) Is there a nucleus in the schizophytes, and if so, what is its structure and the mode of division? Theses must be written in French or Flemish and sent under a fictitious name before August 1st, 1895, to Chev. Edm. Marchal, secretary of the Academy.

M. JULES FERDINAND LUND has found[1] that the age of tubers influenced the effect of dessication upon their respiration. In old tubers collected in the preceding season which had been kept over winter, he found that respiration diminished with the diminution of the water; but when he operated with young tubers collected in April or in May and formed during the season, he found respiration augmented by a rather feeble loss of water.

Dr. J. GRUESS of Berlin publishes an extensive paper in Pringsheim's *Jahrbücher f. wiss. Botanik* (**26**: 379–437. 1894) on the behavior of the diastatic enzymes in seedlings. He holds, in brief, that diastase (or a certain sort of it) behaves in germination in the same way as the sugar, passing from cell to cell as needed. In growing tissues it behaves somewhat differently, for it is stored up there, and is probably used for the solution of the transverse walls in the formation of the tracheæ. Grüss holds it as certain that diastase belongs to the bodies capable of diffusion.

M. LUCIEN DANIEL has been making a thorough study of herbaceous grafting. He has not only studied the subject from the morphological and physiological point of view[2] but now suggests[3] a series of principles for the practical application of herbaceous grafting. He finds it possible to vary the flavor of legumes by grafting on a plant having a different flavor; to retard the flowering of crucifers (and so to avoid hybridization by insects, etc., when it is desired to keep varieties pure); and to create new varieties by grafting after seed formation. He has not been able to graft etiolated herbaceous plants.

THE CAUSES of the arrangement of leaves has long been one of the problems for study of physiologists and many contributions has been made to the subject. Dr. Hermann Vöchting publishes in Pringsheim's *Jahrbücher f. wiss. Botanik* (**26**: 438–494. 1894) a paper on the effect of light in determining the form of the leaf-like Cactaceæ, which he concludes by a discussion of the theory of leaf arrangement. He was able to modify at will the form of these plants, not only altering the leaf arrangement but even the stem structure from isobilateral to radial. The genus chiefly used, Phyllocactus, Vöchting believes to be a very modern one, and the changes induced in it by altering the light to be artificial reversion. In these leaf-like Cactaceæ, therefore, he concludes that leaf arrangement is due to the influence of light upon

[1] Revue Gén. de Bot. **6**: 353. 15 S 1894.

[2] Recherches morphologiques et physiologiques sur la greffe. Rev. Gén. de Bot. **6**: 1894.

[3] Sur quelques applications practiques de la greffe herbacée. Rev. Gén. de Bot. **6**: 356. 15 S 1894.

the growing point. It is not a phenomenon of secondary growth. It may be that in other plants other external agents, notably gravity, produce an effect, and he promises investigation of this and similar questions.

THE FILSON CLUB of Louisville, Ky., has in press for publication in January "The life and writings of Constantine Samuel Rafinesque" by Dr. R. Ellsworth Call. The memoir had its inception in an attempt to clear up certain matters connected with the synonymy of the *Unionidæ*. A number of very remarkable facts connected with the personality of its subject were thus incidentally learned and the author became convinced that Rafinesque had not been always fairly treated by his contemporaries, and that many naturalists now living had formed opinions concerning the nature and value of Rafinesque's work which are quite erroneous. The volume will be in the sumptuous quarto form adopted by the Filson Club, the edition limited to five hundred copies, and issued in paper only. It will contain several full-page illustrations, one of which will be a portrait of its subject. A complete bibliography of the writings of Rafinesque, on every subject, comprising over four hundred titles, will be included.

VERY CONSIDERABLE changes and advances are being made in the department of botany at Smith College. Two years ago a new botanic garden was founded on the college grounds which were laid out for the purpose by Messrs. Olmsted and Elliot. One portion of the grounds is occupied by the herbaceous garden and green house while the remainder, including the campus, is being planted with trees and shrubs grouped principally in their natural orders, but at the same time with regard to artistic landscape effects. The attempt is therefore being made to combine as far as possible the ornamentation of the grounds and buildings with a natural botanical arrangement. The department has been further strengthened by the establishment of a new professorship, to which Dr. William F. Ganong, formerly instructor in botany in Harvard University and lately a student with Goebel at Munich, has been appointed. The former instructor in botany, Miss Grace D. Chester, has been made instructor in cryptogamic botany. The laboratories have been liberally equipped with additional apparatus, and new courses, including graduate work, are being offered.

DR. MORITZ TRAUBE, one of the many genial naturalists who lived and worked at Breslau, Germany, died on the 28th of June. Traube was born at Ratibor and studied at the University of Berlin. His brother, Ludwig Traube the distinguished clinic, was engaged in medical researches when the younger brother arrived at Berlin; when the latter had been made doctor, he worked on the question of diabetes mellitus, mainly from the chemical point of view. But his life's great work was that on the organization of the cell, and on the processes of fermentation and putrefaction. In this connection, we recall his *Theorie der Fermentwirkungen* (1858), his *Experimente zur Theorie der Zellbildung und Endosmose* in Reichert's and Du Bois Reymond's *Archiv.* —: 87. 1867, and his many valuable papers in the *Berichte der deutschen chemischen Gesellschaft*, 1874, 1876, and later. His work on

the production of oxygen by the organism caused a long and most interesting literary debate between him and Hoppe-Seyler. Traube was unable to devote more than a part of his time to investigations, because he conducted the wine business started many years ago by his father at Ratibor. During the last years of his life, Traube lived in Berlin. Since 1886 hehas been member of the Berlin Academy of Sciences. His name will long be remembered in cellular physiology. —BAY.

AS A SEQUEL to his investigations on the origin of the haustoria of Cuscuta and their penetration of host plants, Mr. G. J. Pierce has sought to discover whether common roots have the power to penetrate living tissues.[1] By enclosing seeds of Brassica napus and Sinapis alba between halved potato tubers he found the roots able in twelve days to penetrate the half and even to pass out through the cork layer. On such roots, as on those grown in plaster casts, no hairs develop, which is probably due to the resistance of the medium. The passage made by the root was surrounded by torn, compressed, dead, brown-walled cells, which were enclosed by two or three rows of cells forming new walls parallel to the course of the wound. He found no corroded starch grains, àpropos of which he remarks that the observations of Prunet on the penetration of potato tubers by rhizomes of Cynodon Dactylon may be explained on other grounds than the excretion of a diastatic ferment. Similar results were obtained with the thicker roots of Pisum and Vicia Faba. In three days the pea roots had penetrated 7.5^{mm} without any corrosion of starch. These and other experiments seem to show that the penetration was due to mechanical pressure exerted. Seedlings of the pea were cemented to branches of Impatiens Sultani, a leaf of Echeveria sp., an almost ripe ovary of Fritillaria, a petiole of Rheum officinale, a leaf of Aloe, and a stem of Euphorbia lucida. In all these cases the roots penetrated the superficial tissues to the inner. So the ability and the force needed to penetrate living tissues is not peculiar to the specialized roots of Cuscuta, but is possessed by ordinary plants.

PFEFFER HAS demonstrated that it is the root alone which possesses geotropic sensitiveness. "All previous investigations have been inconclusive because they were judged of by the results which followed cutting off the tip of the root. . . . As regards heliotropism the state of things is easily demonstrated, since the rays of light that act as a stimulus can be easily directed to a single point. On the other hand, it can hardly be thought practicable to expose the root tip alone to the stimulus of gravitation, or in place of this to centrifugal force. We attained the end in another way, however, namely, by compelling the tip of a root, whilst growing quite normally, to take up permanently a position at right angles to the rest. For this purpose we allowed roots of Faba, Lupinus, etc., to grow into short tubes of thin glass that were bent at a right angle. The advancing root easily follows the bend of the tube, and pushes on as far as the other end which has been closed by heat. . . . A geotropic reaction only follows when the tip of the root is not placed in the position of equilibrium, that is, when it is inclined from the vertical. But if the tip is directed

[1] Botanische Zeitung **52**: 169. 1894.

vertically downwards, the rest of the root may occupy the horizontal or any other position, without the geotropic reaction following. By this means, therefore, it is proved with the most perfect certainty that in an uninjured root only the root tip is geotropically sensitive."[1]

"A THEORY of the strobilus in archegoniate plants" is the title of a most suggestive paper read by Dr. F. O. Bower before section D of the B. A. A. S., and published in the *Annals of Botany* 8: 343–365. S 1894. It ought to be read in full by every botanist who is interested in the questions of vegetable phylogeny. The main points of the theory are briefly stated by the author in these words:

1. Spore production was the first office of the sporophyte, and the spore phase has constantly recurred throughout the descent of the Archegoniatæ; the spore bearing tissues are to be regarded as primary, the vegetative tissues as secondary, in point of evolutionary history.

2. Other things being equal, increase in number of carpospores is an advantage; a climax of numerical spore production was attained in the vascular cryptogams.

3. Sterilization of potential sporogenous tissue has been a widespread phenomenon, appearing as a natural consequence of increased spore production.

4. Isolated sterile cells, or layers of cells (tapetum), served in many cases the direct function of nourishing the developing spores, being themselves absorbed during the process.

5. By formation of a central mass (columella, etc.) the spore production was, in more complex forms, relegated to a more superficial position.

6. In vascular plants, parts of the sterile tissue formed septa, partitioning off the remaining sporogenous tissue into separate loculi.

7. Septation to form synangia, and the subsequent separation of the sporangia, are phenomena illustrated in the upward development of the vascular plants.

8. Such septation may have taken place repeatedly in the same line of descent.

9. The strobilus as a whole is the correlative of a body of the nature of a sporogonial head, and the apex of the one corresponds to the apex of the other.

10. Progression from the simpler to the more complex type depended upon (*a*) septation, and (*b*) eruption to form superficial appendicular organs (sporangiophores, sporophylls), upon which the sporangia are supported.

11. By continued apical growth of the stobilus the number of sporophylls may be indefinitely increased.

12. The sporophylls are susceptible of great increase in size and complexity of form; in point of evolutionary history, small and simple sporophylls preceded large and complex ones.

13. In certain cases foliage leaves were produced by sterilization of sporophylls.

[1] Annals of Botany, 8: 317. S. 1894.